THE ELECTRICAL WORLD
A Weekly Review of Current Progress in Electricity and its Practical Applications

PUBLISHED EVERY SATURDAY
AT NO. 9 MURRAY STREET, NEW YORK.
Telephone Call: Murray 586. Cable Address: "Electrical," New York.
New England Office, 48 Congress Street, Boston.
Philadelphia Office, 1005 Walnut Street.
Western Office, 23 Borden Block, Chicago.

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SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.00.
(Postage Prepaid in the U. S. or Canada.)

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Subscription to foreign countries, $4 a year.
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The Editor of The Electrical World, New York.
Subscriptions and communications relating to **Advertising** or the **Business Department** should be addressed to
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No. 9 Murray Street, New York,
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that operate the selecting-plates of the type-setting machine.

Fig. 3 shows the electric connections between the parts, by means of which the selecting-plates are operated. It is plain that whenever any of the perforations in the paper strip *R* come under the feelers 1, 2, 3, etc., the latter make contact with the feed roll and close an electric circuit, energizing at the same time the corresponding electro-magnets. The arms attached to the armatures of the electro-magnets move the corresponding selecting-plates *S*

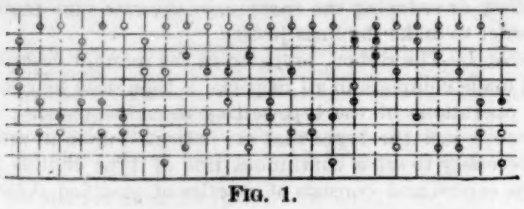


FIG. 1.

and clear a passage for a particular type-pusher. The small holes *P* on the ribbon are used to feed the latter along.

As has been stated, there are as many type-pushers in the machine as there are different "sorts" of type in the composing-case.

Now, as soon as, by a movement of one or more of the selecting-plates, there is an opening formed through the entire series of plates at some one point, the action of the mechanism which operates the type-pushers is such, and is so timed, that at that very instant all of the type-pushers advance and thrust their heads through the openings in the nearest side of the casing inclosing the plates, and attempt each to set the type that is in front of it. But all the pushers are stopped in their forward movement before reaching the types by coming in contact with the sides of the selecting-plates, except the one pusher, in front of which there is the opening that has been mentioned through all of the plates. This pusher, finding no obstruction before it, continues to advance, and is caught by a pawl and carried forward and made to eject its type from the composing-case. The pusher is then returned to its former position, and along with it all the other pushers that had advanced a little, but were prevented from setting their types by the interference of the selecting-plates.

The principal parts of the type selecting mechanism are shown in plan and side elevation in Figs. 4 and 5.

In these *A* is a bed upon which the type-pushers, *B B* slide freely. *A'* is a raised portion of the bed *A*. Of the type-pushers *B B* only eleven are shown at Fig. 4. But in the type-setting machine complete there are over 100 of them. These type-pushers rest loosely in, with their heads pressed gently against the bar *B'*, by springs. *D D* are pawls, corresponding in number with the type-pushers, one of which, at each movement of the machine in its operation, catches in a notch on the top of its type-pusher, and causes it to eject a type from the bottom of its type-reservoir *T*. When not in motion the pawls *D D* rest upon the raised part *A'*, entirely disengaged from the notches in the type-pushers.

In this advanced age of newspaper press associa-

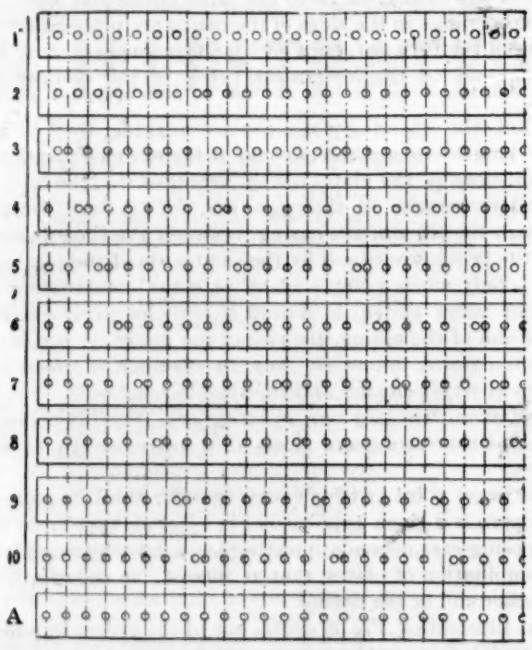


FIG. 2.

tions, it is frequently desirable that the same matter should be put in type so as to be printed at two or more places at a long distance apart. This result has heretofore been accomplished by transmitting the matter by telegraph, or otherwise, in the ordinary manner, to the various points where it is to be printed, and then setting the type in the usual way at each place or printing office. Instead of doing this, Mr. Munson proposes, after a single ribbon has first been properly prepared for operating the selected devices of the type-setting machine, to automatically reproduce the same at as many different places or printing offices as it may be desirable to print the same matter; thereby making all of the operations required to put the matter in type, corrected and justified, at any number of different places, entirely automatic.

For this purpose Mr. Munson has designed a synchronous multiple telegraph.

By this means also the same newspaper may, without extra expense for preparing the operating ribbon, be simultaneously put in type at different places, so as to be there printed and delivered to its readers without the delay now occasioned by transportation from only one publication office.

Mr. Munson has spent much time and labor in perfecting his invention, and lack of space alone prevents our going

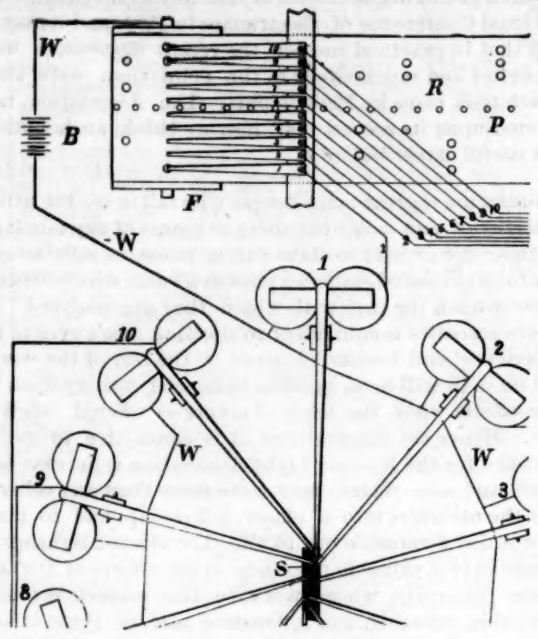


FIG. 3.

into more of the details of his work. There is every reason to believe that, having brought in electricity as a help to type-setting, his machinery will come into vogue.

New England Telephone Stockholders' Union.

At a meeting of the stockholders of the New England Telephone Company, held in Lowell, on Feb. 9, there was a large attendance. The committee appointed for the purpose of forming an organization for the protection of their interest presented its report, which stated that the feeling in favor of such an organization was most favorable among the stockholders. Continuing, the report read:

"There seems to be a universal opinion among those stockholders that they have a just cause for grievances, that the consolidation of 1883 was accomplished by base deception, misrepresentation and fraud; that since the consolidation the interests of the original stockholders in the New England Company have been wholly disregarded, the earnings of the company extravagantly and wrongfully used, salaried offices created for American Bell favorites and money has been used from the New England treasury

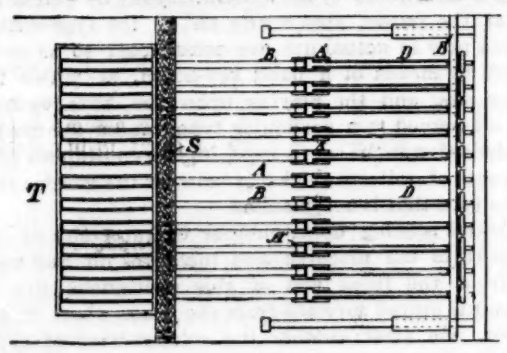


FIG. 4.

for experimental purposes of the American Bell Company; that proof of the lavish use of New England Company's earnings and unwarrantable expenditures for the constructional needs of the distant future is at every hand; that the remarks of Director Hyde of Springfield, at the recent New York meeting, deprecating this wrongful use of money, were listened to and afterward read with no small degree of admiration for that gentlemen's frankness; that inasmuch as the American Bell Company admits the injustice of the present New England contract, it having been stated that said contract was completed under a wrongful idea of the earning possibilities of the telephone business, they conceded that both parties to the contract were thus deceived; that this being admitted, they must acknowledge the moral wrong of their positions; that the attitude of the American Bell Company to-day toward the original stockholders in the New England Company is far from what it should be; that its treatment of them in the past has been unjust; that it never made a concession except for the matter of policy and for the purpose of influencing legislation; that in consideration of all this, there is no cause for kindly feeling on the part of the New England stockholders toward the American Bell Company, nothing that calls for thankfulness, but much that calls for redress."

The report which recommended the formation of an organization for the purposes above indicated was accepted and adopted. These officers were elected: President, John J. Pickman, of Lowell; Secretary, Charles L. Knapp, of Lowell; Executive Board, W. H. Prentiss, A. B. Hayward, of Keene, N. H.; G. B. Chandler, D. B. Varney, of Manchester, N. H.; H. C. Gratton, of Worcester; George A. Marden, T. T. Greenhalge, W. H. McDaniel, W. H. Ward, T. R. Garity and J. G. Butterick. By-laws were adopted, also the name "New England Telephone Stockholder's Union." The American Bell's concession was 3½ per cent.;

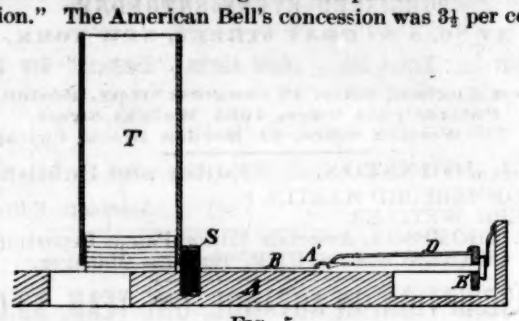


FIG. 5.

the expression of the new organization indicates that it will now be satisfied with 5 per cent.

Improved Power Indicator Applied to Ide Engines.

The cut below represents Mr. Ide's improved patented power or cut-off indicator, which he has just perfected and applied to his high-speed automatic cut-off engines. In a prior issue of THE ELECTRICAL WORLD we described this indicator, in which the index-hand or pointer of the indicator was attached to and moved by the rocker-shaft of the engine connected with the valve, so that the index-hand moved or vibrated continuously during the operation of the engine. Such continuous movement of the hand has, however, been found objectionable, especially in the use on the smaller engines, making as many as 600 strokes per minutes, for the reason that in consequence of the rapid movement of the index hand it was difficult to note upon the scale with exactness the limits reached by the hand in its movement.

To avoid this defect, the improved indicator, as shown by the above cut, is provided with an index hand, which instead of being directly attached to the rocker-shaft, is movably supported or pivoted independently of the rocker-shaft; and the end of the latter (which conveys the travel or motions of the valve) is provided with a yoke with two separate projections or stops which engage and move the hand. The stops are located at the proper distance apart to allow for the lap of the valve, so that when the engine is running without load, the stops will not move enough to engage the index hand, and it will remain stationary in a central vertical position at the zero mark, and as the load is applied to the engine and the valve travels a greater distance each way to admit more steam to the ports, the yoke through its stops will engage the index hand in alternation; the hand being carried to one end or side of the scale by the movement of the stop and there allowed to remain until engaged and moved by the other stop in the return movement of the valve.

By this construction the hand obviously remains stationary at the extreme limits of the movement given to it during a considerable part of each stroke, thereby giving ample time for the observer to note the extent of its movement upon the scale.

The scale is graduated to indicate in inches the point of the travel of the piston, at which the valve closed or cut off the supply of steam, and enables the observer, by noticing the steam pressure, to readily ascertain the horse-power the engine is developing. This is an important matter, as it allows the person in charge of the engine to regulate or carry his steam on boilers at a pressure that

IMPROVED POWER INDICATOR.

will make the engine cut off at the most economical point for the work being performed, and thus obtain the highest results in economy of fuel.

Holding on to His Stock.

An interview reported from Washington under date of Feb. 16 represents Mr. Garland as determined for the present to hold on to his Pan-Electric stock, until the approaching investigation is over, when he believes he will be acquitted of blameworthy conduct. He welcomes the investigation, he says, but declines to discuss the matter in detail. Being asked whether his attitude pointed to resignation from the Cabinet, he said it did not. This denial should dispose of the report that he was about to give his stock to a charity, and to give up his Cabinet position.

First Annual Meeting of the National Electric Light Association.

In accordance with call, the first annual meeting of the National Electric Light Association was held at Baltimore, Md., in the Carrollton Hotel, on the 10th, 11th and 12th inst. The following gentlemen were present:

A. H. Bauer, Viaduct Manufacturing Co., Baltimore, Md.; H. P. Brown, Brown Electric Co., Chicago, Ill.; George L. Beetle, American Electrical Works, New York; J. L. Barclay, Holmes, Booth & Haydens, New York; C. W. Boyer, Philadelphia, Pa.; S. M. Bryan, Washington, D. C.; George T. Carter, Brown Electric Co., Pittsburgh, Pa.; W. M. Callender, Callender Insulating and Waterproofing Co., New York: F. E. Cabot, Boston, Mass.; W. L. Candee, Okonite Company, New York; H. M. Cleveland, Waterhouse Electric Mfg. Co., Hartford, Conn.; Joseph A. Corby, St. Joseph Electric Light Co., St. Joseph, Mo.; W. H. Coughlin, Worcester, Mass.; W. B. Dowse, New York Insulated Wire Co., Boston, Mass.; D. D. Dickey, Pittsburgh Carbon Co., Pittsburgh, Pa.; S. A. Duncan, Allegheny County Electric Light Co., Pittsburgh, Pa.; A. J. De Camp, Brush Electric Light Co., Philadelphia, Pa.; D. H. Dorsett, Chicago, Ill.; Andrew J. Dam, New York; Ensign Duncan, U. S. S. Juniata, New York: D. C. Evans, Brush Electric Light Co., Baltimore, Md.; James English, Newport Electric Illuminating Co., Newport, R. I.; H. N. Fenner, New England Butt Co., Providence, R. I.; L. M. Fishback, Parker-Russell Mng. and Mfg. Co., St. Louis, Mo.; W. H. Fitzgerald, Brush Electric Light Co., Detroit, Mich.; H. P. Frost, New Haven, Conn.; Frederick Fosdick, Fitchburg Engine Co., Fitchburg, Mass; H. H. Fairbanks, Worcester Electric Light Co., Worcester, Mass.; F. A. Gilbert, New Haven Electric Light Co., Boston, Mass.; Allan V. Garratt, Chemical Electric Light & Power Co., Boston, Mass.; Clark B. Hotchkiss, Kerite, New York; George W. Hebard, United States Electric Lighting Company, New York; H. Harding, Massachusetts Electric Power Company, Boston, Mass.; A. H. Hayward, Daft Electric Railway, Baltimore, Md.; F. W. Harrington, West. Electric Company, Chicago, Ill.; A. S. Hickley, New London, Conn.; W. C. Kerr, Westinghouse, Church, Kerr & Co., New York; Pierre O. Keilholtz, Johns Hopkins University, Baltimore, Md.; T. S. King, Minneapolis Electric Supply Company, Minneapolis, Minn.; H. M. Linnell, Schuyler Electric Light Company, Hartford, Conn.; M. D. Law, Brush Electric Light Company, Philadelphia, Pa.; J. A. Pentz, Porter Allen Engine Works, Philadelphia, Pa.; E D. Libbey, New England Glass Works, Boston, Mass.; E. T. Lynch, Jr., United States Illuminating Company, New York; F. Latshaw, McKeesport Electric Light Company, McKeesport, Pa.; E. A. Maher, Albany Electric Illuminating Company, Albany, N. Y.; D. L. Mitchell, Taunton Electric Light Company, Taunton, Mass.; J. F. Morrison, Southern Electric Company, Baltimore, Md.; T. C. Martin, THE ELECTRICAL WORLD, New York; Col. Fred. A. Mason, Bridgeport Brass Company, Bridgeport, Conn.; Chas. McIntire, Newark, N. J.; T. McCoubray, Jr., Morrison's Electrical Works, Baltimore, Md.; Everitt Morse, Morse & Whyte, Boston, Mass.; W. H. McGrath, Brush Electric Light Company, New York; Dr. Otto A. Moses, New York; H. K. McCay, Baltimore, Md.; E. S. Mullen, Thomson-Houston Electric Company, Philadelphia, Pa.; J. F. Noonan, Paterson Electric Light Company, Paterson, N. J.; Charles W. Price, New York; A. B.Proal, Viaduct Manufacturing Company, Baltimore, Md.; Ralph W. Pope, New York; H. W. Pope, Elizabeth, N. J.; Eugene F. Phillips, American Electrical Works, Providence, R. I.; Geo. F. Porter, Pittsburgh Carbon Company, Pittsburgh, Pa.; Henry A. Reed, Bishop Gutta Percha Works, New York; T. W. Rae, New York; D. R. Russell, Parker-Russell Mining & Mfg. Co., St. Louis, Mo.; E. E. Ries, Baltimore, Md.; Prof. H. A. Rowland, Johns Hopkins University, Baltimore, Md.; Fred. Royce, Washington, D. C.; F. W. Rollins, *Commercial Bulletin*, Boston, Mass.; R. W. Ryan, Official Stenographer, New York; R. S. Robinson, Providence, R. I.; Brainard Rorison, Jenney Electric Co., Indianapolis, Ind.; J. E. Sweet, Syracuse, N. Y.; C. E. Stump, THE ELECTRICAL WORLD, New York; Frank G. Stone, Ansonia Brass & Copper Co., New York; G. C. Sims, Armington & Sims, Providence, R. I.; H. W. Spang, Ball Electric Light Association, Reading, Pa.; H. S. Stanley, Bridgeport Electric Light Co., Bridgeport, Conn.; J. A. J. Shultz, Shultz Belting Co., St. Louis, Mo.; W. F. Swift, Brush Electric Co., Cleveland, Ohio; A. C. Shaw, Callender Insulating & Waterproofing Co., New York; C. M. Thompson, Callender Insulating & Waterproofing Co., New York.; D. H. Tuxworth, Southern Electric Company, Baltimore, Md.; C. L. Travis, Minneapolis Electric Supply Co., Minneapolis, Minn.; A. F. Upton, Jarvis Engineering Co., Boston, Mass.; C. J. H. Woodbury, Boston, Mass.; E. R. Weeks, Kansas City Electric Light Co., Kansas City, Mo.; George Worthington, New York.

About 12:30 P. M. on the 10th the members who had arrived having assembled, the President of the Association, Mr. J. Frank Morrison, took the chair, with Mayor Hodges on his left, and after calling the meeting to order, said:

The success which has attended our association so far must be very gratifying. Its numbers, its popularity and its usefulness must also afford you a great deal of gratification. From a small group of men who gathered together at the Pacific Hotel, Chicago, one year ago, it has grown to an association numbering hundreds of members, and its influence has already been felt through all the ramifications of the electric lighting business. We meet as scientists and practical men. The former indicate the course along which the practical man may walk and achieve such results as past history promises the future. Baltimore extends the hand of welcome to you, and I may say that all electrical apparatus invented in this country has had its birth or to some extent its fruition in this city. The telegraph, the telephone, the electric light, the electric locomotive have, to some extent, first been made accomplished facts here. At our last meeting at the Hotel Dam, in New York, a distribution of the subjects presented to the convention was made to various committees, whose reports and the accompanying papers you will be called upon to consider. We have with us Maryland's representatives and the mayor of the city. The subjects to be discussed will include electricity as an illuminator, arc vs. incandescent lights, the placing of wires under ground, operating expenses, the relation of electric lighting to insurance, etc. The names of the authors of the papers are a sufficient guarantee of the intelligent manner in which their subjects are likely to be handled. Among those who have accepted invitations are Professor Rowland, of the Johns Hopkins University, whose reputation in electric matters is not confined to his own country; Ensign Louis Duncan, of the United States Navy, chairman of the committee on the life tests of incandescent lamps and dynamos, instituted by the Franklin Institute of Philadelphia; Prof. Kimball and Dr. Perkins, of the Johns Hopkins University. I have no doubt that during the session they will offer many valuable suggestions. I have now the honor of introducing to you the Hon. James Hodges, mayor of the city of Baltimore, whose name has been for nearly half a century identified with everything that was beneficial to the city of Baltimore—one who not only encourages progress, but keeps along, step by step, by her side; one whose words of welcome come not merely from the lips, but are the genuine expression of the heart, the great heart of the hospitable people of Baltimore."

With this introduction, Mr. Hodges rose and delivered an address, in which he said:

As the mayor of Baltimore, I extend to the delegates of the National Electric Light Association a sincere and cordial welcome to this city. As it is one of geographical centrality, whose inhabitants are proverbially kind-hearted and hospitable, I deem it not egotistical to remark that the place of your meeting is well chosen. I am only repeating a platitude when I say that safety to life and property and good living and good cheer are among the distinguishing characteristics of this community, and I underwrite this bond to you.

The people of Baltimore cannot but feel a lively interest in the questions to be discussed in this convention. It was here, in 1844, that Morse first brought into successful operation his telegraphic line, connecting the cities of Baltimore and Washington. No grander result can ever be achieved by human genius over space and time. I witnessed its first operation at this end of the line in a brick building which stood on a small part of the ground now occupied by the City Hall, with a feeling of awe and wonderment from which I have never recovered. A few days afterward I went to Washington with some friends on a visit, and was introduced to Professor Morse in his office at the Capitol. He explained his ingenious invention to us with a display of enthusiasm which was as childlike as it was delightful. It was here, in 1848, that George B. Simpson exhibited the first successful submarine telegraph, the one now in practical use by all telegraph companies.

It was here in 1878 that the first practical test was made between the original Bell telephone and the Edison carbon transmitter, which resulted in favor of Edison and brought about the consolidation of the two interests. Baltimore was the second city on the American continent, in 1881, to apply on a large scale the system of electric lighting to its public thoroughfares; and the first, in 1885, to equip and put into successful operation the electric railroad, which connects the village of Hampden with this city. Hence, as I have before intimated, the place of your meeting is most appropriately chosen. You have assembled here to develop and promote a science of great utility to the world; and which, in my judgment, is only in the infancy of its application to the necessities and comforts of mankind. As a means of protecting life and property, the system of electric lighting is only second in efficiency to an honest and efficacious police. Men are deterred from committing crimes under the glare of electric lights, though seemingly alone, for fear that some one from a distance, screened from view, may be looking on. An electric light is a nocturnal joy to an honest man, but a scarecrow to a thief.

I never shall forget the thrilling impression made on my mind by the first electric light I ever saw. It was in Paris, 1878, that I first beheld the display of this wonderful invention. The Arc de Triomphe, the crowning glory of the Champs Elysées, was surrounded by electric lamps, and the great white marble memorial to Napoleon Bonaparte was made to shine in the distance like a beacon of hope. The sight was captivating to my senses, and I thought I had never witnessed a more remarkable effect produced by means of illumination. But a still greater delight awaited me, and I realized it when I saw the Avenue de l'Opéra at night, one of the most magnificent streets in the world, illuminated by long ranges of electric lights, in ornamental lanterns, mounted on lofty artistic lamp-posts. No language could describe the enchanting brilliancy of the scene. It was one of the attractive sights of Paris, and I continue to think of it with unabated wonder and delight. Since that period, as you know with much greater particularity than I do, the uses of the electric light have become greatly enlarged, diffused and diversified. Not only night building, but night harvesting, can be carried on successfully when necessary. This was demonstrated in France as early as 1878 by means of a movable Gramme machine, which illuminated the field while the harvest was progressing.

I will not venture to be instructive to this intelligent body of scientists, at whose feet I might sit to study the principles and appliances of electricity, but I will ask your indulgence so far as to say what, doubtless, you already know, that recently the electric light has been utilized as a means to aid medical and surgical diagnosis, and to assist, by its internal application, to illuminate the various dark cavities of the human form, which surgeons and physicians have had no previous means of exploring. This has been accomplished by the invention and application of an ingenious little electric light supplied from a small portable battery. But I will not talk to you any longer about a matter which you understand much better than I do. I will simply renew my best wishes for the success of your convention, and for the best possible mixture of social and intellectual enjoyment for yourselves while sojourning in our city.

Mr. E. R. Weeks then read the following paper on

THE PROPER CONSTRUCTION AND MAINTENANCE OF CIRCUITS.

As the subjects of underground conduit and incandescent lighting were assigned to other committees, the following notes will apply to aërial arc circuits only.

Under the head of construction may be considered line wire, supports, lamps, and station connections; under that of maintenance, lines, lamps and dynamos. Since the important subject of line wire was given to another committee, its discussion is omitted.

To guard against "trouble" and to facilitate its removal, the line should, as far as possible, be in sight from the ground, and should be so placed as to be readily reached. By such construction, trouble and the cost of attendance are reduced to a minimum, and one is freed from the endless complications of housetop work, with its manifold objections, *i. e.*, rights to be begged, bought or stolen; continuous delays in removing "trouble;" costly repairs to roofs, chimneys and fire-walls; together with all the thrilling adventures of a lineman.

On some narrow and overcrowded streets, it may be policy to erect iron standards; but the danger of fire and of ground shocks is so great with such supports, that those of wood are much to be preferred.

To prevent the insulations being cut by tie wires and to guard against excessive slack from stretching, poles should not be more than one hundred feet apart. With the best material and good workmanship, and by paying more attention to the general appearance of the line, we may gain in efficiency and do much toward silencing the outcry against overhead wires.

Aside from the necessity to comply therewith, the rules of the Board of Underwriters should be observed, because they are founded in reason and are *generally* conducive to the interests of all parties. There *must* be a positive "cut out" on every loop. But, instead of placing it upon the building containing the lamps to be cut off, it has been found better to provide for it a special pole or support, as near as possible, of course, to the entrance to the building, but independent of it or of any structure which is likely to be destroyed by fire. By so doing, control of the circuit is retained in the event of the total destruction of the building containing the loop. There have been instances where such an arrangement would have saved the circuit and prevented loss from rebate. Where high tension currents are employed, porcelain should not be used for outside insulation. The best insulators for this service are of hard rubber and of glass. By means of wall-blocks and brackets, rubber hooks and glass insulators may be used for all outside work where it is common to employ porcelain knobs.

In entering buildings additional insulation of hard rubber tubing should be used. To avoid damage from water, have entrance holes bored upward from the outside, and let the wire run from a fixture placed below the exterior opening, so that all drip shall be away from the building. For like drainage purposes, glass insulators are to be set at an upward angle and rubber hooks pointed downward.

Lamps must be suspended by some perfect insulator; vulcanized rings being the best known to our experience. The best service is given by stationary lamps. This is especially true of outside lights. Those hung with raising and lowering tackle are more liable to wear, breakage and variable contacts than are rigid lamps; and in cold weather the tackle may become so clogged with ice as to render them inaccessible. For like reasons, when it is necessary to place the light toward the middle of the street, some device similar to the Brady mast arm will prove most satisfactory.

Hoods should be sufficiently large not only to protect the lamp from the weather, but to allow access to its works while it is in service. The conical form, since it offers least resistance to the wind, is preferable to other shapes.

Globes should be deep enough to cover the arc when the lamp is trimmed full, and the aperture at the top should be no wider than will just allow the rod and holder to pass freely.

The dynamo room should be a clean, dry, well ventilated apartment. In no other can electrical machinery be kept in a condition to do the best and most reliable work. Let every dynamo be set on some sort of frame by means of which the tension of the belt can be easily changed, and in addition, let it be carefully insulated from this frame by blocks of paraffined wood or some other equally good insulation. Wires from the machine to the switch-board are best run either by way of the ceiling or beneath the flooring. Under no circumstances should they be laid upon the floor, where they are not only in the way, but are sure to lose their insulation through dirt and wear.

All station wires should be cased in rubber tubing as high as a man's head, and cables and lines connected with the switch-boards must have similar coverings to guard against short circuits, fire and injury to employés. To protect both machines and lamps, and the property of patrons, every circuit ought to have lightning arresters at the station, one on each wire.

The proper maintenance of lines requires that all other wires be excluded from electric light poles. The apparent economy of partnership poles is more than offset by the increased care required to maintain lines in good condition. Such a combined system will result in greater danger of crosses and grounds, fires will be more frequent, and the lives of men unacquainted with the handling of electric light wires will be jeopardized.

The insulation of circuits should be tested several times daily, and all lines patrolled frequently. In searching for grounds, and in repairing open circuits, much time may be saved by using a magneto. Having attached the two wires of the open circuit to the station bell-box, the line man, with a duplicate magneto, goes to the break. When the wires are ready for connection, he uses the magneto to signal the station that the current may be turned on in five minutes, or some other previously determined period. In this way a search for a telephone or a walk to the station will be avoided and rebates will be reduced.

Dirt must not be allowed to accumulate on any part of the lamp. Rods, bases, switches, contacts, bushings and globes should be kept clean, and screws well set. Rods require frequent burnishings with crocus cloth. Let there be a system of rigid inspection at varying intervals, and full and exact reports from the inspector as to the work of each lampman.

If properly tended, lamps need very little adjusting. In nine cases out of ten, adjusting simply means cleaning. But one man should attend to the adjustment of any set of lamps, and these, if properly cared for by the lampman, ought to run for a long period, with little other attention. As often as once in two years at least it is well for the lamps to be returned to the station to receive a thorough overhauling, and to be repainted that they may present as creditable an appearance as possible.

In the annual contract with the consumer there should be a clause especially stating that any working with the lamp by other than electric light employés will relieve the lighting company from all responsibility for failure of light. Employés should be provided with badges worn in plain sight.

Machines run in series do not give as good results as when run singly. The tension is increased to the danger point, while oscillation and all other kinds of trouble are more difficult to overcome.

The insulation of dynamos must be tested as often as is that of the outside circuit, and all circuit connections and binding foot screws must be kept tight.

Having given the machine the most favorable setting, it still needs intelligent attention to maintain it in an efficient condition. Except in an unusual emergency the necessity for calling an expert will generally mean that the machine has not had proper care. The insulating parts will probably be found greasy and gummy and coated with metallic dust, which destroys insulation and causes trouble of various kinds.

In conclusion, it may be said that if circuits are properly constructed and cared for, they should work satisfactorily. If they do not do so, if they are in constant need of repairs, if lamps require frequent adjustments, if bushings are continually burning out, the *meaning* is careless attendance; and of all this carelessness, failure in cleanliness will be found the most common fault. Given a well-constructed circuit, cleanliness is the ounce of prevention that will obviate 90 per cent. of the vexations of electric lighting. (Loud applause.)

Mr. Cooper remarked that in Brooklyn they found that the poles were near enough to each other when 250 feet apart; certainly 150 feet, instead of 100, was quite close enough.

Mr. King explained the operation of the system in use by his company in Minneapolis for suspending their arc lamps at street intersections, running the lamps out by means of a sheave, pulley and winding drum. It was found a cheap, effective and popular system. The cost was $6½ for the apparatus.

Mr. Cooper and Mr. Lunnell both said they had met with practical opposition and objection to running lamps out across the streets.

Mr. Ridlon: The greatest objection to the stringing of lamps in this way is the liability to accident from the fall of a lamp, which weighs from 50 to 65 lbs. I have known cases where running the lamp to and fro has worn the suspending wire away so that the lamp fell, with great danger to people and carriages passing. It is strongly objected to in New England, and in Worcester they have had one or two accidents of that kind, bringing down not only the lamp but the circuit; and they have gone to considerable expense and built a sort of tramway for the lamp to run out on, capable of supporting at least two or three hundred pounds.

Mr. Cooper stated that their experience in this respect from accidents had cost them in Brooklyn $1 500.

Mr. Weeks contended that as the pole system involved cheaper construction and cheaper maintenance the other plans must fall to the ground. Where tackle was hitched to a house it had to be moved should the house be pulled down. He knew of a case where a man had a 75-foot derrick, and had it moving up and down until he brought the electric light people to terms. Another great and insuperable trouble with these movable lamps was the variable contacts.

Mr. Smith, of Jamestown, N. Y., said they used a rope in connection with their lights; but it was pointed out that in practice it was found that evil disposed persons could meddle with the rope.

The reports of the treasurer, Mr. Cooper, and the secretary, Mr. H. E. Reinhard, were then read, showing a balance of $862.48 to be on hand.

In the absence of Mr. George S. Bowen, of the committee intrusted with the subject, Dr. Otto A. Moses then read the following paper on

ELECTRICITY AS AN ILLUMINANT.

In the following brief review your committee on Electricity as an Illuminant have thought it advisable to treat of the advance in electric lighting as having been marked by periods of activity. The present uniform development indicates the near approach of another period in the history of this new and great industry, when electric light will occupy the position now held by gas as an illuminant. The subject is one that engages universal public attention, owing to the extent and wide distribution of gas interests, and because of the possible effect the growth of electric lighting may have on the value of petroleum and natural gas in situ, as one of the future sources from which most illumination will be derived for use in the populous parts of the country.

In the conflict between electricity and gas as an illuminant, there is no point of advantage in favor of gas, except its cheapness. But this advantage will every day diminish, while the superior healthfulness of electric light, and its greater safety against fire, and the ease with which it lends itself to decoration, must force its acceptance by the public long before the equality of cost is reached.

We have divided a short history of electric light into five periods, which we will call by the following titles:

1st. The period of Davy.
2d. The period of Starr and Staite.
3d. The period of the Alliance machine.
4th. The period of the Paris Exposition.
5th. The coming period.

Each one of these first four epochs have been marked by some great and essential development in which electric lighting approached much nearer to perfection.

THE PERIOD OF DAVY.—In 1813 Sir Humphrey Davy was engaged in establishing his fame in a series of brilliant lectures at the Royal Institution. He had decomposed the alkalies and had produced sodium and potassium in their metallic state by means of the powerful current from a battery of 2,000 zinc copper elements. With these cells he was the first to make the electric light.

In his classical experiments he produced:

1. The arc light in air, and in the vacuum of an air-pump.

2. The incandescent light in air, and in the vacuum of an air-pump.

3. For these purposes he made use of small pencils and rods of carbon from vegetable fibre, and in the dense form of the diamond.

4. He discovered that a point of rarefaction in different gases could be reached where the arc would not pass.

Schemes of electric lighting as early as this may naturally have floated in the heads of visionary inventors; but if they ever experimented in this direction the rapid polarization of Sir Humphrey's primitive batteries and the difficulty of keeping an air pump tight would soon have dispelled their hopes. Gas, too, had just been introduced into London with great éclat; for we read of the vast illuminations made with it in honor of the crowned heads who visited that city after the fall of Napoleon I., and so electric light was laid aside.

From 1813, when Davy experimented with the electric light, until 1841, when Archereau and Deleuil used it to illuminate the Place de la Concorde, in Paris, nothing seems to have been done to develop the necessary machinery for its automatic working, those gentlemen being compelled to push the carbons by hand as they were consumed.

In the mean time Grove (1832) had invented his depolarizing battery, and Bunsen had modified it by substituting carbon for platinum and incidentally the latter had learned to make artificial carbon better adapted than wood charcoal for arc lights.

So bright a light as that produced by Deleuil with 100 Bunsen cells, and one so well adapted for fine effects could not fail to attract inventors. In the same year another departure in electric lighting, incandescence of platinum and charcoal or plumbago in vacuo, was made by an Englishman named F. de Moleyns.

THE PERIOD OF STARR AND STAITE.—It was not, however, until 1845 that any serious attempt was made to introduce small electric lamps into public use, when J. W. Starr, a native of Cincinnati, went to England with an incandescent lamp having a carbon made to give light while in a Torricellian vacuum and over mercury. Here, with the assistance of Mr. George Peabody, the banker, he introduced it, but soon after died.

The next year a very ingenious Englishman named Staite took up the subject of electric lighting in all departments, and in a short space of time produced excellent arc lamps embodying many principles now, or recently, in use. He also patented an incandescent lamp in which the illuminating organ made use of was iridium, as superior to platinum. He also much perfected the carbon used in arc lighting.

The great difficulty in his way was the want of a cheap source of electricity, batteries being found too expensive. This defect prevented his success.

Here the matter seemed to rest (if we except Archereau's application of the solenoid to arc lamps in 1848) until the invention of the dynamo machine furnished the missing link to the chain which had to be wrought before electric light could be commercially produced.

It is, perhaps, well here to note that it is claimed by M. de Changy that he and M. Jobard, of Brussels, in 1855, had made, but not operated, incandescent lamps identical in form with lamps now in general use; but his claims are not substantiated.

It may also be mentioned that simultaneously with the invention of the dynamo-electric machine a patent was taken out in England (by one Shepard) for a Belgian inventor named Nollet, presumably the same person as he who conceived the dynamo (now in operation) called after the company who manufactured it, the Alliance machine, and which remarkable machine, when constructed and improved by Van Malderen, first rendered electric lighting feasible.

The perfect germs of this engine were, however, found buried in the small magneto electric instruments of Pixii, Clarke and Page, which had been constructed almost immediately after Faraday announced his grand discovery of magneto electric induction.

It is also necessary to recall that Elias, and Stöhrer, in 1844, King in 1846, Dujardin in 1847, Henly in 1849, had already done a great deal to render the dynamo possible.

THE PERIOD OF THE ALLIANCE MACHINE.—The Alliance Machine was originally intended to be used as a source of light by employing, for that purpose, the gases of water decomposed by its continuous currents. This fallacy was soon abandoned and the machine converted into an alternating current one to be applied to electric lighting. It was set at work in a light-house at Havre, where it is today (as one of your committee has seen) doing very good work, never having been out of order from the day it started in 1863.

A host of able inventors then began to develop the dynamo machine. Among these we would call especial attention to one who was far in advance of his time, and the anticipator of many recent inventions: Hjorth of Denmark, who in 1854-55 took out excellent patents in which the principle of augmenting electric currents by the reaction of electro-magnets upon each other was clearly described; as also the principle of exciting the field magnets by means of permanent ones.

Werner Siemens, of Berlin, constructed his armature in 1856.

Professor Holmes, of England, made a machine which, when approved by Faraday, was used by the British government in an important light-house in 1856.

In 1858, an unknown inventor (represented by J. H. Johnson, of London) first suggested the auto-exciting principle which afterward was independently discovered and presented to the Royal Society by W. Siemens and Wheatstone.

In 1860, a new departure was made in the history of electric lighting by Antonio Pacinotti, of Italy, who constructed continuous current dynamo machines (which he also used as motors). In these most remarkable machines all the principles now employed are found. But it is worthy of notice, although attention has never yet been called to the fact, that the auto-exciting capacity of the field magnets (above referred to) escaped the inventor's observation; and also the action and reaction principle first observed (we believe) by Fontaine on accidentally coupling two Gramme machines together.

Wilde (1863), Varley (1866), Wheatstone and Siemens (1867) constructed machines containing the principles of the inventions just referred to, but which were independently discovered by them.

Prof. Rowland, of Baltimore, also about this time (or even before) had devised apparatus containing leading principles.

As your committee only propose to indicate the chief periods of development in the dynamo in its relation to electric light, we must here call especial attention to the machine invented by Z. T. Gramme, of Paris, in 1869.

Although this machine was entirely an original invention, it varied little from that first described by Pacinotti in "Il Nuovo Cimento" in 1863; still, its simplicity and efficacy caused an entire revolution in the production of electric light.

In the time which elapsed from the date of its invention to the Paris Exposition (1881) electric lighting became a business; but only by means of the arc light.

However, the possession of so convenient a source of electric power as the dynamo gave a great stimulus to inventors, and several again took up the subject of incandescent lighting. This new enterprise began in Russia, and in the course of a short time Messrs. Lodyguine, Konn, and Bouleguine, of St. Petersburg, constructed and put in operation, commercially, incandescent lamps with thin carbons in vacua, contained in glass globes cemented in various ways.

Experiments had also been made with Geissler tubes by Messrs. Benoit who employed them as a source of light for miners' lamps.

It is necessary here to recollect that the invention of the Geissler and the Sprengel mercury pumps; the elaborate and classic studies of Plücker, Crookes, Gassiot, De la Rive and others; and the perfection attained by Carré, Gaudoin, etc., in the manufacture of electric light carbons, had paved the way for the successful invention of incandescent and semi-incandescent lamps; and thus enabled Werderman, Jablochkoff, Swan, Edison, and many other inventors, to engage in their manufacture and perfection; so that at the Paris Exposition in 1881, it was possible to show lamps that have not undergone much change in form since that day. So much so that capitalists became convinced that electric lighting had reached a point where they could invest in its development.

THE PARIS EXPOSITION.—This period is memorable for the wonderful impetus given to electric lighting and for the opportunity it afforded to investigate the claims and merits of rival inventors by a comparison of the extensive collections of historic apparatus exhibited. Other expositions exclusively devoted to electric subjects were held in London, Vienna, Munich, Philadelphia and other places, and through their united influence electric lighting has impressed itself upon the business of the age.

THE COMING PERIOD.—Much has yet to be done by discovery, invention and development before electric lighting will occupy the commanding position it will inevitably assume. In conclusion of this report your committee would call attention to the new fields which are to be explored and to the directions in which what we have is to be developed and perfected.

CENTRAL STATIONS.—The distribution of electric power from central points is going to be the future source of energy, for light and other purposes, in cities. These points will be in the coal, petroleum and gas districts and in the neighborhood of large water powers. The power which will reach the cities will be stored at central stations, or be transformed there for general distribution. Enormously expensive and cumbersome systems of distribution will be abandoned, and currents of high potential must be safely transformed in o currents of low potential at the door of the consumer, or, if not needed, be stored for future use. At present, central stations employ their capital fruitfully only about six hours in twenty-four. This must be avoided by using the plant, when light is not wanted, in storing and distributing currents of different potentials to local transforming centres of consumption by means of more than one system of radial conductors.

TRANSFORMATION DIRECT OF FUEL INTO ELECTRIC LIGHT.—The greatest problem that can now occupy the mind of the electrician is the generation of electricity directly by decomposition of the hydrocarbons, etc., without the intervention of the dynamo. The solution of this problem will simplify the production at the coal fields, etc., and the discovery will reward the one who makes it with untold wealth and honor.

There is an immense field for activity in perfecting and applying thermo-piles, accumulators, potential transformers, Geissler tubes, incandescent lamps, arc lamps, semi-incandescent lamps, meters, gas engines, etc., to electric light purposes.

The engineer who applies himself to these subjects has a mine of wealth before him. Let him remember that electric lighting as a business did not exist ten years ago, and let him also recollect that the gas lighting is the largest manufacturing industry in the world, and that electric light will be welcomed in every place wherever gas has poisoned and blinded with its fume and flicker.

At the close of the paper, which was very cordially received, Dr. Moses made a few statements of a historical nature as to the fact that Pacinotti made his first machine as a motor, when the idea flashed across his mind that he would make it a generator—as shown by the attachment of a pulley and axles. It was strange that Pacinotti with his thorough grasp of principles as exhibited in the dynamo had not arrived at the idea of its reversibility.

Adjourned.

Upon the opening of the afternoon session, Mr. R. W. Ryan, official stenographer, read in behalf of Mr. John W. Beane a paper on

THE HISTORY OF ELECTRIC LIGHTING.

The paper besides covering part of the ground traversed above by Dr. Moses offered a long and interesting statistical survey of the growth of electric lighting throughout the world, and stated that in the United States and Canada the light finds its widest application, since in the United States there are upwards of 95,000 arc and nearly 250,000 incandescent lamps distributed in over 400 cities and towns. "Only thirteen years ago Prof. Tyndall exhibited at Horticultural Hall in Philadelphia probably the first arc lamp seen in public in the United States (it was a poor specimen of the arc lamp as we now know it) and at the present writing there are not less than $70,000,000.00 invested in the business of electric lighting in this country alone; at least 25,000 incandescent and 12,000 arc lamps are newly installed each year. Over six tons of mercury and 700 air pumps are in use for the manufacture of glow lamps. In Paris in 1878 the cost to the city was at the rate of 29 cents per hour for a lamp of from 500 to 700 c. p. To day, under like general conditions, the city of New York pays at the rate of about 6 cents per hour for a lamp of 2,000 c. p. There are 300,000 carbons manufactured for arc lamps in the United States daily, one of our large firms consuming 25 tons of petroleum coke per week.

"To those who have watched the progress of electric lighting this bright survey of the present state of the art cannot but also recall the dark days of 1881 when, surrounded by distrust and suspicion following a season of wild speculation, the outlook was gloomy indeed, especially so in Europe. Who but the most sanguine could then have predicted what we see to-day.

"The future prospects of electric lighting are indeed flattering, and when we consider that of all commercial enterprises the capital invested in illumination is second only to that employed in transportation, the vast possibilities before us may be realized. We have seen the budding and will soon behold the flower."

The following paper was then read by Mr. T. C. Martin, for Mr. W. J. Johnston, on

THE HISTORY AND PROGRESS OF ELECTRICITY AS APPLIED TO MOTORS.

Mr. President: In compliance with your request for a report on the History and Progress of Electricity as applied to Motors, I beg to submit herewith for your consideration what must naturally be regarded as but a brief outline of this important and growing application. Important as the subject now is, however, one would not hazard much in venturing the assertion that in the future it will, with but one or two exceptions, outstrip in magnitude all other developments of electricity.

Notwithstanding the attention we have paid to electric lighting, I and those associated with me in journalistic work have given much careful thought and devoted considerable space to discussing and recording various applications of electricity to power. I presume that this is the reason why you have assigned the subject to me; and I am glad you have, for it gives me an opportunity of laying before the Association some suggestions and recommendations in regard thereto, which I deem of especial value to electric lighting interests.

The designation "Electricity as applied to Motors" may upon analysis be made to include considerably more than is usually understood by that phrase, for it cannot be gainsaid that many applications of the motors, though in a disguised form, could be brought under the above heading. Thus, when we turn the crank of a magneto call on a telephone line, we set a motor in operation at the other end whose work consists in striking a bell and producing a sound. In the same way the telegraph sounder must be considered a motor, and it need hardly be said that many more of these examples could be cited. But I do not believe I will be taken to task if I pass over these forms and limit myself to motors in the restricted sense. I shall further take the liberty—in fact, the necessary limits of this paper compel me—to confine myself to the motor of to-day, which is the one that particularly occupies the attention of those engaged in electric lighting.

Though the electric motor existed long before the dynamo, it attained no prominence until after the discovery of the continuous current machine. There were two reasons for this. In the first place, the galvanic battery constituted the source of power, and it is almost needless to say that so long as this condition obtained, the application was restricted. The second reason must be sought in the defective construction of the early motors themselves. These, with but few exceptions, were so made as to generate but comparatively weak counter-electromotive force, and hence the work which could be obained from them was small in comparison with the power expended and their size. The advent of the continuous current dynamo, however, at once removed the dependency upon galvanic batteries; but, more than all, the discovery of its reversibility put the electro-motor upon a firm foundation and opened up for it a wide sphere of usefulness.

While Pacinotti and Siemens deserve credit for having perceived this valuable property, the discovery of which may be ranked as one of the most notable of modern times, it remained for M. Hippolyte Fontaine, in connection with M. Gramme, to demonstrate it upon a real, practical scale. This was accomplished, more by accident than by design, at the Vienna Exhibition of 1873, and the history of the electric motor since that time alone would fill volumes.

When the fact of the reversibility of the dynamo became generally known, enthusiasts proclaimed that a revolution in the application and distribution of power would ensue, but that such has not so far been the case you all know. The electro-motor, like all other machines, has to be adapted to existing circumstances, and questions of economy have more to do with such matters than questions of sentiment.

As might be expected, one of the first uses to which the electro-motor was put was the transmission of natural powers to centres of manufactures distant from the source.

All water falls can be utilized to drive turbines and dynamos without difficulty, but to transmit the electricity so generated to a long distance economically presents quite a formidable problem. There can, of course, be no transmission without a conductor, and for the transmission of large powers correspondingly large conductors are required. M. Marcel Deprez has, perhaps, more than any one else, devoted himself to this problem, but the results that even he has obtained are far from satisfactory. According to his theory, the resistance of the line does not affect the economy of the transmission, but this evidently is based on the assumption that high electromotive force is employed. His first actual experiment in long-distance transmission took place during the Munich Exposition of 1882, when he transmitted one-half horse-power over an ordinary telegraph wire from Miesbach, a distance of about 35 miles. He had long before that time devoted his particular attention to this subject, and since then he has on various occasions experimented with new forms of machines. The most recent of these has been on a line from Paris to Creil. Backed by a French syndicate, he has undertaken to transmit 100 horse-power over a distance of about 35 miles, using a silicious bronze wire 5 millimeters in diameter. He claims to have succeeded thus far in transmitting 40 horse-power with an economy of 50 per cent., under certain conditions, which it is not necessary here to discuss. But what, may well be asked, will these experiments result in? That power can be transmitted we all know. Given, then, that M. Deprez succeeds in his attempt, will that alter the present condition of affairs, as regards the economical side of the problem? The cost of his installation, and the interest thereon, will far exceed the similar items, including maintenance of a steam plant of equal power, at the place where it is wanted.

Yet, paradoxical as it may seem, the great problem to be solved is not the transmission of 100 horse-power, but of thousands and tens of thousands. Now, this can only be done in one of two ways; by increasing either the electromotive force or the current. If the latter plan is pursued, an increase in the size of conductor must necessarily follow with its attending cost, and this is feasible, but not at present economical. On the other hand, can the electromotive force be increased much beyond the limit which M. Deprez is now using? Dynamo builders know how perfect the insulation of the armature must be, and how little it requires to burn one out under but slightly abnormal conditions. Those especially who have experimented with the 40, 50 and 60 arc light machines using two or three thousand volts, have possibly, on more than one occasion, witnessed an effect in the armature as if the latter had been struck by lightning. This effect is one entirely different from what would be produced in a machine in which the armature has been actually burned out by a heating of the wires from too great a current. The break resembles that made by a disruptive discharge, an actual spark; and M. Deprez has already experienced one of these mishaps, in spite of the fact that he uses two layers of silk and one of cotton for the insulation. The fact is, a dynamo of large power which is subjected of necessity to rough influences cannot be made to generate currents of very high electromotive force for a continued service, on account of the impossibility of securing sufficient insulation. As has been pointed out in THE ELECTRICAL WORLD, the problem bears considerable analogy to that of the steam engine. The use of high pressure steam of, say, 500 or 1,000 pounds to the square inch would effect great economy, but it is materially impracticable, as the cost of building engines and boilers to withstand these pressures would be out of proportion to the benefits derived, and no working joint could withstand the pressure. I have dwelt at length upon this question, as it is one that deserves careful attention.

For the reasons given above it would appear that as regards long-distance large power transmissions, substantial improvements are required before it can become a commercial success.

Leaving this part of the subject, the results of which are still in the tentative state, we come to the successful application of the electro-motor, by which power is transmitted to a limited distance. By far the most important progress made in the employment of the electro-motor is that in its relation to the running of railway cars.

Siemens and Halske deserve the credit of having installed the first electric railway in which the current was generated by stationary dynamos. It was at the Berlin Exposition in 1879 that a line of 550 yards was laid down, upon which a small locomotive drew passenger cars merely as a novelty. Since that time the electric railway has been the particular study of many keen and active minds, and the application has extended considerably. This has particularly been the case where the motive power heretofore employed was supplied by horses. It must be evident, that for equal power the use of steam directly or indirectly is considerably more economical than animal power, and hence for city railways in which steam locomotives are objectionable, the electric railway solves the problem.

Glancing at the various systems that exist and that have been proposed, we meet a diversity which is the natural result of the labor of different minds. This difference consists not only in the method of leading the current, but the manner of distribution. Siemens and Halske's first railway was equipped with a central insulated conductor from which the current was taken off by contact brushes, the rails being used as the return, and this method has been largely imitated. The original arrangement has, however, been variously modified to meet various objections, the principle remaining the same. An overhead conductor has also been employed with success, in which a sliding contact is maintained between the conductor and the car. Such a system has for some time been in successful operation in various cities in this country and also abroad.

For street railways it is evidently undesirable that pedestrians or animals should be liable to come in contact with the conductors, and another method consists in placing the conductors in a trench between the tracks, contact being made by an arm which passes through a narrow communicating groove. Other methods have been suggested and tried, but I merely mention these to indicate that the problem has been solved in various ways.

As has been stated before, the electric railway will, without a doubt, be the future one for city traffic. In our own country numerous workers have attacked the problem in different ways, and the success already obtained leaves no doubt for the future.

The question is often asked whether our great railway lines will ever be operated by electricity. It would be rash to say that they never will be, but under existing circumstances the present system will probably remain in vogue for some time to come. We shall perhaps see the first advances made in this direction by railways so situated that the item of fuel is of importance.

Thus far we have confined ourselves principally to the passenger electric railway, but an equally large field is open to the electric railway for other purposes. I refer particularly to its use in mines and tunnels, for the hauling of ore or other material. This has already been attempted in several instances and with eminent success, and it seems strange that more is not done in this field, which seems such an inviting one.

As a cognate development of the electric railway, the ingenious system of "Telpherage," invented by the late Prof. Fleeming Jenkin, deserves attention. I need not describe it, as the subject is fresh in the minds of those who are acquainted with this subject. The telpherage system, however, marks a decided progress in the field of the application of electricity to the transmission of power, and the recent opening of an operating line at Glynde, in England, will no doubt be followed by the construction of others. The great flexibility and the cheapness of construction of the system eminently adapt it for rough localities, and telpherage also possesses elements of great value in making it possible to transport goods to the highroads of commerce from points which heretofore were beyond easy reach.

Since electricity has become practically available as a motive power, it has given a wonderful impetus to a number of undertakings which had previously been in the conceptive or embryo state. Chief among these is the art of ballooning. By the aid of electricity remarkable progress has within a few years been made in the way of an extended application of this heretofore uncertain method of locomotion. The recent experiments of Renard and Krebs have shown that the balloon equipped with the electro-motor can be depended upon for reliable service, and when the storage battery shall have been—as it will be—sufficiently improved as regards weight per stored energy, the balloon will have a value both for purposes of war and peace which can now be hardly estimated. Quite recently an ingenious method of transmitting power for the propulsion of balloons has been suggested by Gen. Thayer, of the United States Army. His method makes the balloon captive to the conducting wires, which transmit electricity to a motor carried by the balloon. The system strongly resembles that of telpherage. In fact the only difference is that the balloon relieves the conductor of the weight of the passing load, which in the telpher line is carried by the conductor. When we consider the rapidity with which a line can be built, and the comparatively small power required to propel a balloon at a good speed, Gen. Thayer's scheme seems quite promising.

The war departments of various nations have taken up the subject of the application of electro-motors, not only in the navigation of the air as just mentioned, but of the sea, both on and below the surface. The torpedo propelled and steered by electricity conveyed from the shore or ship is fast superseding those propelled by compressed gases, and the fast torpedo boat deriving its power from the storage battery is now the subject of active experiment, the Russian Navy having recently tried such a boat with good success. For small pleasure boats, the last method described will surely find extended application whenever the storage battery shall have emerged from the difficulties under which it now labors.

The telegraph has also been advanced a step by the application of electro-motors. The latter has made it possible to obtain practically perfect synchronism in the revolution of two wheels placed at each end of a telegraph line. Mechanical appliances, without the aid of electricity, had been found inadequate for the purpose, and the small electro-motor alone has made the Delany and Calahan system of multiplex telegraphy a possibility.

Thus far the electro-motor has been discussed principally in its relation to the past. This, however, is a fitting occasion to cast a glance toward the future and to consider some points which are of special interest to this Association. I refer to a general distribution of power by electricity. In considering this problem, it may be well at the outset to set at rest some misconceptions which have unfortunately gained ground, due to the unguarded statements of enthusiasts. The question of economy is a matter of great importance here. The cost per horse-power per annum when using a stationary steam engine as the prime mover is a quantity variable with the conditions of the engine and the magnitude of the power. It is evident that a plant of one hundred horse-power or more can be maintained more economically per horse-power than one 25 h. p. or less. It would take me too long to demonstrate this by actual figures, and indeed the statement is so obvious that it hardly requires special demonstration. It is evident, therefore, that with increasing powers a point is reached at and beyond which the cost of power can be maintained in an independent establishment with equal economy to that of a central station itself, but that below that point the power can be supplied more economically by electricity from a central station. It would be impossible to lay down a universal rule as to this critical point in the power, for evidently it must vary according to locality and other conditions.

While the exact limits are variable, a slight consideration makes it evident that a general power distribution must be designed, so as to meet the requirements of a large number of comparatively small motors in circuit. I need not recapitulate many attempts that have been made to supply the demand for a small motor to perform intermittent services of widely differing character. Modern civilization has created almost as great a demand for power as for such other adjuncts of convenience or necessity as light, water and heat. The advent, within the last few years, of numerous small gas, steam, water and petroleum engines, bears witness to this.

How many small workshops there are in which a reliable power from a central station would be a boon. In how many situations would such a small motor replace costly manual labor or animal power. A little consideration of this subject cannot fail to impress any practical man with its importance, and to give rise to the hope that it will soon receive the attention it deserves. When we consider further the fact that a double copper conductor, one square inch in section, is able to transmit 250 horse-power over a moderately long distance, without appreciable loss and without danger to life, and take this in connection with the present low price of copper, we must all admit the advisability of studying the problem of power distribution with the same energy as that of the electric light.

Several attempts have already been made to utilize lighting dynamos during the day time for the purpose of running electro-motors in the circuits.

There seems to be no good reason why most electric light stations should lie idle and unproductive during 10 hours of the day when with their spare dynamo or two to guard against accident, they could easily be converted into a power station. Reference is here made particularly to arc light stations (as they are at present in the majority) in which the wires existing are strung overhead, so that a motor in a building can be attached without any delay or interruption of service.

In order to make such a service feasible, however, the electro-motors employed whether they be in series, as on arc circuits, or in parallel, as on incandescent lamp circuits, must be designed so as to maintain uniformity of action under the most varying external conditions. Uniform speed under all conditions of load is probably one of the principal requisites of any motor, and hence not less so of the electro-motor, and different constructors have solved the problem of securing the desideratum, by mechanical or electrical means, into a description of which it is not necessary to enter.

But while good regulation is an essential element in a successful motor, that of high efficiency is of perhaps still greater importance. While the electro-motor has been the subject of extended study, it cannot be said that any definite and generally accepted rules have as yet been laid down regarding its construction, in the same sense, at least, as for the dynamo. That considerable remains to be done in this field is evidenced by the fact that up to the present the efficiency of motors has, as a rule, been comparatively low. There seems to be no good reason, however, why the electrical efficiency of a motor should not approach that of the dynamo, within limits, and the proper proportioning of parts and the study of their interdependence can alone bring about improvement over the present state of things. The efficiency,

while comparatively low in large electro-motors, is still lower in the small ones, which is particularly unfortunate, from our point of view, as it has already been shown that the small motor will constitute the principal factor in an electric power distribution. It may be set down as an axiom that a small machine rarely equals in efficiency a large one of the same type, but the difference which exists in the case of the electro-motor is in many cases out of all proportion and irreconcilable with the simple conditions involved. As has been recently pointed out in THE ELECTRICAL WORLD, the small electro-motor requires a thorough overhauling, and already one of our most prominent electricians has succeeded, by a series of experiments, in obtaining efficiencies in a small motor which have rarely been attained by the largest. These experiments are not yet finished, and hence are not ready for public discussion, but they will soon form the subject of general attention, as they mark a decided advance.

While recommending the utilization of electric light stations for power distribution during the day time, I would have it borne in mind that various conditions must be observed which necessarily enter into such a problem, and in which both the engineer and electrician could be profitably consulted.

The length already attained by this paper prevents me from giving more attention here to the history of electricity as applied to motors. I have already touched upon it incidentally. The sources of information on this branch of the subject are so numerous and so well known that I have taken it for granted that electric light men are generally acquainted with the past, and that it is the present and future that is of the most practical interest and value to them.

The future of electro-motors was never so bright as at present, and when our electricians shall devote themselves to this field of applied electricity with the same zeal as they have shown in other departments, we may expect as great an advance in the solution of the power problem as has been effected by the electric light in that of illumination. The field is "white unto harvest," and only requires intelligent working.

I wish to say here that in the preparation of this report I have received valuable assistance from Mr. Wetzler, of the editorial staff of THE ELECTRICAL WORLD, who has devoted much thought and attention to the transmission of power. In conclusion I trust that this paper will have some effect in drawing the attention of electric light men to this important subject, and that we shall all live to see and enjoy the full realiza ion of the expectation of early enthusiasts regarding the electro-motor.

At the close of the paper, Mr. Martin stated that Mr. Johnston had hoped to be present himself, but was unable from ill health, having contracted rheumatism in a blizzard and snow-storm while on his way to Chicago to attend the first meeting of the Association. In fact, Mr. Johnston's attendance at the first meeting had unfortunately been the means of precluding him from attendance at the third.

Mr. A. F. Upton said that they must all have heard with interest and profit the very able paper just presented, and he added the subjoined remarks: At the electrical convention held last August in New York City, in a paper I had the honor to read at that time, in speaking of electric lighting stations, the following remark was made: "There is one thing occurs to me I think electric light companies should take into consideration, and that is, letting of power."

At the Edison Company's station, Lawrence, Mass., a large number of Sprague motors are used which run all day. They use from half a horse-power to five horse-power each. These Sprague motors are all employed at a good profit, and it has always seemed to me that every electric light company should use their power in the day time to run small machinery. You have it in your stations; why not use it?

Since then, information on this subject has been sought in every way and from all available sources. Electric power, in many places, has for some time been sold from central stations, just as steam power is sold, and with profit to both seller and buyer. In Boston, this has been done by the Daft Electric Power Company, using the Daft system, and considerations of the results here attained will suffice to show the commercial value of electric transmissions. Dynamos are run by an Armington & Sims Company's engine, at a central station, supplying electric power to about thirty motors in various parts of the city. It is sold at $150 per horse-power per year, the price at present being about the same as that for steam for small powers. It is a curious circumstance that more power is sold than the engine can supply—a paradoxical state of affairs explained by the fact that almost no set of machinery is kept running steadily, and the company supplying power gains by the stoppages. At this station they have in use two Daft dynamos of 25 horse-power each that are run by being belted direct to a 50 horse-power Armington and Sims engine. The steam is generated in a steel tubular boiler set with the Jarvis furnace, and coal screenings are used for fuel. This power is transmitted all over the city, and is used for running all kinds of machinery, including sewing machines, ventilator fans, printing presses, elevators, and other work. The demand for power far exceeds the supply, as the company have let all the capacity of their engine, and have applications for 300 horse-power more. It is the intention of this company to start a large central station to be run exclusively to let power. The present plant has been in operation over eighteen months, and the only interruption has been three hours, when other parties cut their wires by mistake. In many cases these motors have supplanted small steam engines, gas engines and hired power. Customers claim that the power is more regular than they have ever used before even when coming from the adjoining buildings. There is in Boston one engine running 29 elevators; if every elevator was used at the same time the engine would not have over one-half the required power.

From all the information gained, the actual loss in the process of conversion of power into electricity and transmitting power from the dynamo to the receiver amounts to about 40 to 50 per cent. The manufacturers of the dynamos claim only a loss of 30 to 40 per cent., but it is a safe calculation to allow a loss of one-half. This, as has been explained, is more than made up by the excess of power that can be actually sold and paid for. Electrical transmission has the unparalleled advantage of being superior to the obstacle presented by distance. Then again, it operates its miracles in perfect silence and repose. No force appears in the wire such as appears in shafting, in pipes with compressed air or water, in endless chains or belts; and, in case of powerful currents, insulation is easy. The conductor can be bent or shifted in any way while transmitting many horse-power, provided, of course, its continuity be not interrupted. It can be carried round the sharpest corners, through the most private rooms, into places where no other transmitter of power could possibly be taken. There is nothing to burst or to give way. In short, such a method of transmission is the acme of dynamical science. At the present time steam is the foundation of electrical power. Water power is unsteady and not reliable; gas motors are of limited power. With improved steam engines, belted direct to dynamos and the Jarvis process of utilizing low cost, waste fuels, the cost of making power has been reduced within the past few years fully one-half.

The most important use to which the principle of electric transmission of power is at present being put, is the running of street railways. It was only a little over five years ago that the first electric railway was built in Germany, and to-day there are many in that country where their practical success has been demonstrated. In France and England they are fast becoming popular, but it seems that those in America are yet almost of an experimental nature; in this branch of electrical science at least, America is far from foremost.

The advantages of electricity over steam for railway purposes are many and great. In the first place, the bulky locomotive is done away with, as the electro-motor can be placed either under the car or on trucks by itself; in either case great weight and room being saved. The machinery for converting the coal into the power, or rather extracting the power from the coal, is not portable, but stationary, and can be placed in the most convenient spot. For transmitting the power, in many cases no difficulty has been experienced in using one middle rail as the conductor. Sometimes it has been found that the dirt sticking to the rails and the wheels formed a sort of crust so insulating as to prevent adequate communication. From all the information I can gain on this subject, it is my opinion that the most practical way will be to use wires on poles. I understand this system is used in the West by the Van Depoele Company. The poles can also be made available for stringing electric wires for both incandescent and arc lighting. The future of this system is filled with possibilities. It will eventually become the motive power of all the present horse railroads. In a few years elevated electrical railroads will be as plenty as steam railroads are now, and in time it will supersede the present system of running locomotives on all railroads—and why not? It is simply a question of cost of making power. It is acknowledged by every practical engineer that the present system of making steam in locomotive boilers is expensive as well as wasteful. The evaporation of pounds of water to each pound of coal consumed to make steam in locomotive boilers does not average over three and one-half pounds of water, using the best grades of bituminous coal, while with stationery boilers set to burn coal screenings for fuel, an evaporation of nine pounds of water to one pound of fuel is made, and the reduction in cost of fuel is from one-third to one-half. It is only a question of time when all the different electric lighting stations in this country will use their engines in the daytime to make power to be sold for manufacturing purposes, the same as they sell power in the form of electric lights now. They can also furnish power to run electrical railways, elevated or surface. The economy of this system over the cost of running horses, as used now, will be over 50 per cent.

As to speed, it is impossible to give the limit which can be reached on electric railways, because those so far constructed are on streets or in localities where very rapid transit is not possible or desirable. On the very first one built, a rate of seven miles per hour was customary. On the Berlin railway, opened in 1881, the greatest speed reached was at the rate of 18 miles per hour. More was possible, but the police authorities refused to permit more than 9 miles per hour. Up to August, 1882, there had been no breakdown on this road. On the Siemens railway, at the Paris Exhibition of September, 1881, a distance of over 1,600 feet was traversed in a minute, which is at the rate of nearly 20 miles per hour. There is every probability that electric locomotives can be run faster than any steam locomotive now in use. About 10 miles an hour is the average speed that a car can be run on an electrical street railway, but I think it is possible to run at the rate of 100 miles an hour. In the near future, on elevated railways, this will no doubt be accomplished. I believe the time will come when cars will be run by electricity between Boston and New York in about two hours' time, where it now requires six hours by steam railroads. We Yankees call ourselves practical people; we believe in the success of the use of electricity for elevated and surface street railways; believing this, we propose to put it into actual practical operation. Petitions are now before the present Legislature of the State of Massachusetts for charters for over a dozen street railways, part surface and part elevated, all to be run by some system of electric motors. In Massachusetts a horse railroad can be started under the general law, but as the law stands now an electrical railway requires a special charter. A petition has been presented asking for an amendment to the General Law and allowing electrical railways to be started the same as horse railroads are started now. We believe that the cost of power, as compared with the present cost of using horses, will show an economy of over 50 per cent. In the town of Winthrop, Mass., near Boston, sufficient money has been subscribed for erecting an elevated railway on the Enos system, to be run by electricity. The station will be constructed so as to include the use of dynamos for electric lights, and the elevated railway will be utilized for stringing wires to run them. If the charter is granted, work on this railway will be started at once. The plans are all made for an electrical station three stories high, the upper stories to be used as a manufactory and power supplied from the station below—a most profitable way of utilizing the power of electric light stations in the daytime.

The electric station of the future will be erected to utilize power in hundreds of ways not now thought of. Central stations should be made large enough to combine all the present methods of using electricity, with full allowances for future discoveries, for I believe electricity is in its infancy. By this strange and novel agency power will be used to do its share toward the support and advancement of the human race. We may yet know, in our time, what electricity is, for to-day we only know it is a power that shows itself by its manifestations.

A professor in a college asked a student one day what electricity was. The student hesitated and tried to think of the correct answer, but in vain; it was of no use. He could not recall it, but in self-defense said, "I did know, but have forgotten." The professor replied, "This is terrible. The only man who ever knew what electricity was has forgotten the answer."

Electric light and power stations will be erected in the future as large as our present cotton mills; the engines will be used in the day-time to run lines of shafting to furnish power for manufacturing purposes, over the station; power motors will transmit electricity all over our cities to run small machinery. Both arc and incandescent lights will be used. Perhaps storage may yet be a success. Electricity will be used to drive machinery, to produce ventilation, for heating purposes; the exhaust steam will also be used for heating neighboring buildings in cold weather.

There is no need to expatiate upon the advantages to be gained from an economical method of transmitting power, the costly and persistent attempts of inventors and capitalists to get better methods are enough to prove their desirability.

Many systems have been tried and found wanting. In electricity, thanks to living inventors, we have a force into which power can be transformed, as by the wave of the magician's wand, a force which flows to any distance with the rapidity of lightning and the stillness of a ray of sunlight, and then at bidding resumes its original shape quicker than thought can follow it.

An animated discussion ensued, it being evident from the remarks made that the members were becoming keenly alive to the importance of an early investigation of the power question. As to Lawrence, Mass., Mr. Martin said he had had lately a letter from the Lawrence *American*, in which it was stated that that paper was effecting an economy of not less than 40 per cent. on power cost by the use of electro-motors, besides being free from the trouble and annoyance of a steam plant of its own. Mr. De Camp thought that in order to furnish the power, stations must have new equipment, the spare or reserve plant being altogether inadequate for such purpose. He stated, however, that his company in Philadelphia were now running a number of sewing machines, averaging twelve to the horse-power. An alternative was suggested by more than one member in the use of storage batteries, should it not be desired to enlarge the plant, and Mr. Morrison expressed from the chair his firm conviction that the storage battery would within the next twelve months do all that might be required of it in this line.

An invitation was extended to the Association to visit and inspect the Hampden electric railway (Daft system, illustrated and described in THE ELECTRICAL WORLD of Feb. 13, 1886). An invitation was also extended by the Association to the insurance men of the city to hear a paper by Mr. C. J. H. Woodbury on electricity in its relation to insurance.

The first session on Thursday, the 11th, opened at 10 A. M., when Mr. F. Fosdick made an address on the subject of

STEAM POWER AS APPLIED TO ELECTRIC LIGHTING.

The address was in reality a very able plea for low speed, long stroke engines for electric lighting, as compared with the high-speed engines that are so popular and so much in vogue. He said he remembered the period, about six years ago, when the question of electric lighting was first brought to public attention in the United States at an exhibition in Boston. There were shown the Wallace-Farmer light, built at Ansonia, with a wide, thin carbon, and the Brush light as used now. The business was then in its inception, and the initial steps were taken at that time. The light was under severe criticism as a new thing. Unfortunately for the light, the dynamo was connected with an engine in that building which did not give a regular speed. The dynamos being imperfect they required a more regular speed than they now do. The result was that the lights at that fair were a failure. After the fair, however, the Brush light, which had been poor and variable, happened to be placed in an establishment on Washington street, Boston, where it had the advantage of a higher speed engine, controlled by a good governor and giving 220 revolutions and the same dynamo which had not given satisfaction, now in its new place yielded results that were perfectly satisfactory. Those in charge drew the inference that regular high speed was essential to a satisfactory and perfect light, and hence sought to obtain that condition. Since those days the dynamo had itself been greatly improved, and hence the necessity had ceased for that close regulation for the arc light, and the hypercriticism of old as to the light itself had ceased as well. In a word, the light is not to-day so dependent upon absolutely close regulation as it was at that time. Close regulation being then essential, the engine chosen to run the light was considered more in its relation to regulation of speed than in regard to close economy of operation, the object being to get a successful electric light; and it was then found, as is true theoretically, that the higher the speed the closer is the regulation. Hence, high-speed engines went with electric light dynamos, and it has been hard to dissociate the two ideas. To-day the perfected electric light competes with gas, and there had come up immediately the question of comparative cost. The question is not to-day one of the amount of light as of lighting a given district for so much, and the question having been settled that the electric light was right and a success, the pressing question of economy in competition with gas came up. Those who built high-speed engines had had the advantage, but those who built low-speed engines had also been trying to meet the conditions for running electric lights, and within the past two years the subject of the comparative superiority or economy of high and low speed engines had again come to the front prominently. There were now those who had made the experiment both ways, and were thus qualified to decide practically as to the merits of the two systems. It was the fact that now many of the largest stations in the country were fitted up with low-speed engines, higher in speed, perhaps, than the old low-speed, but still "low-speed" as compared with engines of the distinctively "high-speed" types. These stations were giving marked economy, and where there had been the direct comparison, the decision had been, he thought, that the light with low speed has been as good while the economy has been much greater. It was true, too, that the larger the engine, the closer the economy, regardless of "high" or "low." The question came in here in a new shape, as to whether not only in the large stations but in stations requiring, say, 100 or 150 horse-power, the

low-speed engines would not yield a greater economy. There were certain elements of cost entering into high-speed engines that were inevitable and inseparable from them, and those elements conduced to low economy—such as increased friction in proportion to the power of the engine, and increased clearance; and these in his opinion more than offset, as objectionable, the friction with low-speed engines resulting from extra lines of shafting, etc. That was the opinion of the committee he spoke for, though what he expressed was principally his own view of the case. There were certain places where high-speed engines must come in of necessity, because of lack of room preventing the application of the longer stroke, or because of the inability to run the lines of shafting essential to low-speed engines. But where such conditions did not exist, the low-speed engine was preferable. Mr. Fosdick then touched briefly on boilers, recommending the steel tubular, and discussed the various opinions that prevail as regards proportion of grate surface to heating surface, the nature of fuel to be used, the distance of the grate bars from the boiler, and the extent of the draft. These and other matters, such as pumps and injectors would, however, naturally rest in the control of the competent engineer having charge of the steam plant.

Mr. Upton, while not agreeing with all the report, thought it a fair one and well put. He avowed his belief in "high speed," and said that to-day of the stations in the United States, half at least of the arcs used high-speed engines, and three-fourths of the incandescents. He knew of places where low-speed engines had been used, but had been replaced by high, because it was possible with the former to count by the flicker of the light the number of revolutions. Without one single exception the stations using the Armington & Sims high-speed engines put in by his firm were paying dividends, a fact which he thought settled a good many of these points.

Mr. DeCamp repeated the statements he made at the last meeting in regard to the evidence offered by the Philadelphia station in favor of the safety, efficiency, and greater economy of low-speed engines, the prejudice against which among electric light people was dying out. He found it economy to run his Corliss engines on even a very small load, as compared with running smaller engines.

Mr. Evans reported that in Baltimore they had started with high-speed engines in the Brush station, but had replaced with larger ones. He had demonstrated by several tests that there was more economy in running the latter. One objection to high-speed engines was that if anything got loose there was no possibility of saving the engine, whereas with the long stroke you were able to examine all the parts while running. In Baltimore they had run Buckeye engines for three years and had not shut down any of them from any cause whatever after once starting to run through the watch. The Ball engine they had put in four months ago was giving them excellent results also, but taking it all round, he preferred the long stroke. At the same time, he got the best results with Jarvis setting.

Mr. McGrath said that in their New York Brush station they had 1,600 horse-power nearly all made up from slow-speed engines. Being asked as to the fuel consumption, Mr. McGrath said they did not figure it in pounds of coal, but that it cost $2\frac{9}{10}$ cents per lamp of 2,000 candle-power for 10 hours.

Mr. DeCamp said that in Philadelphia they got at the coal per lamp per hour, by taking the total number of lights per month, the total number of average hours run, and the money spent for coal.

Mr. Morrison said that the Baltimore company based the cost of its lights on the total cost of burning. He did not intend to tell the convention what it cost to burn a lamp for one night, as it might scare the stockholders. The company, he said, pronounced in favor of large, low-speed engines. The cost of electric lights depended primarily on the cost of fuel. Here the quantity of fuel used was four pounds and a fraction of fuel per lamp per hour, the fuel being composed of three tons of screenings to one of soft coal. The next item of expense was the cost of the carbons, which formerly cost $65 per thousand. Some of them for "summer" use can now be bought for $10 per thousand. He paid $12.50 per thousand. The Baltimore company's light compared favorably with any in the United States. They did not confine themselves to Brush carbons, but went also into the open market, buying the Parker-Russell, the Boulton, the Pittsburgh and the Forest City carbons. The third item was the cost of superintendence, a skilled man who took an interest in the company's business. There was a fourth item as regarded line maintenance.

At this point the discussion was brought back to steam power equipment.

Mr. Kerr deprecated the drawing of hard and fast lines as to either high or low speed. It behooved each man to find out what he needed to meet the conditions of his station. As to coal consumption, he thought with Mr. Morrison that they wanted to get at figures that would apply to all stations, such as the quantity per lamp. The cost would vary with many circumstances, and even the best experiments on any point were very liable to error. Figures in ordinary terms, giving coal per horse-power or per lamp, from the various stations, would yield a fair result.

Mr. Linnell thought the amount of coal per light was very indefinite, really meaning nothing with lamps giving so many different degrees of light. Besides the same instruments of comparison were necessary.

Mr. Smith, of Jamestown, N. Y., in a pretty vigorous speech, accused Americans of extravagant engine practice, and said they were altogether behind the age in economy in engines. He was strongly in favor of compound condensing engines as used in England.

Mr. Cooper replied that in Brooklyn to use such an engine would involve greater cost for water than for coal.

Mr. Lynch said that in the new United States station in New York they were using a 500 h. p. Watts & Campbell condensing engine, taking water from the East River, with a consumption of $1\frac{7}{8}$ lbs. of coal per horse-power, pea coal.

Mr. Gardener C. Sims, in meeting forcibly the criticisms as to American engine building, gave some remarkable figures as to the durability of the Armington & Sims engine, and instanced many cases, showing its great popularity not only in England, but all over Europe, and in South America. As to slow speed, he had been fortunate enough, he said, to replace several large engines with his, with the result of large gains in the organization of the station, mechanically and pecuniarily. They would run a 50 horse-power engine with a coal consumption of $3\frac{3}{10}$ lbs. per horse-power.

Mr. Kerr said, with regard to four years' experience with the Westinghouse engine he furnished—the first of its kind that had achieved a reputation in this country—they were more than pleased with the small amount of repairs necessary, and even those repairs had been largely due to the use in the earlier stages of materials no longer employed in its construction.

On motion of Mr. Noonan, it was *Resolved*, That the Committee on Transportation of this Association be composed of seven members. Two from the South, two from the East and two from the West, who shall constitute sub-committees to report to the chairman, who shall be the seventh member. The chairman shall announce, through the electrical press, 30 days previous to the opening of any convention, whatever arrangements have been made with the railroad companies for reduction of fare to said convention.

A committee, consisting of Messrs. De Camp, Gilbert and King was appointed to nominate officers for the ensuing year.

On motion of Mr. H. W. Pope, article 3 of the constitution of the Association was amended so as to declare that "associate members shall pay the same dues as active members, and have all the rights of active members, except the right to vote, and with the consent of the executive committee shall be appointed on committees." A communication was received from Secretary Barney of the National Telephone Exchange Association, relating to a standard wire gauge. This led to the presentation of the following:

Resolved, That the New English Board of Trade standard wire gauge, adopted by the National Telephone Exchange Association, September 8, 1884, be and the same is hereby adopted as the official gauge of this Association.

Resolved, That the President take such steps as in his judgment may seem necessary through a conference with the Telephone Association or other associations interested, toward inducing Congress to legalize the same in the enforcement of contracts.

Resolved, That 1,000 copies of said standard gauge be printed for distribution by this Association.

Referred to committee of three.

The committee appointed to tabulate the rates of the various companies for lights was made a standing committee, to report at the next convention.

The President appointed the following Committee on Transportation:

East—J. F. Noonan, Paterson, N. J.; Henry D. Stanley, Bridgeport, Conn.; Jas. English, New Haven, Conn. South—L. M. Fishback, St. Louis, Mo.; W. Yarborough, Nashville, Tenn. West—Geo. Wadsworth, Cleveland, O.; S. A. Duncan, Pittsburgh, Pa.

The Association having invited some distinguished European electricians to become honorary members, acceptances were read from Prof. S.P. Thompson, R.E. Crompton, Z. T. Gramme, Dr. J. Hopkinson, Prof. Geo. Forbes, Joseph Wilson Swan, J. T. Sprague, and E. Hospitalier, of *L'Electricien*.

Adjourned.

At the opening of the afternoon session a long telegram was read from President E. H. Goff, of the American Electric Manufacturing Company, expressing his sympathy with the objects of the Association and his desire for its success.

Considerable time was occupied in discussing the proper pronunciation of the word "dynamo," Mr. Weeks contending that the accent should be on the first syllable, with the "y" pronounced short, and Mr. Cooper upholding the "American way"—pronouncing the "y" long, with the accent on the same syllable. The opinion of the meeting was in favor of the long "y."

Mr. Ralph W. Pope then read a paper, or report, on

UNDERGROUND WIRES.

The six months which have passed since your last meeting, although not productive of material progress in the burial of the wires, have at least been instrumental in bringing to the attention of the people generally some of the difficulties which are encountered in this work. Having arrived at the conclusion that the important subject of subterranean systems was practically confronting us, either for good or for evil, your committee was represented at all of the public meetings of the New York Commission on Electrical Subways which were held subsequent to its appointment. Over one hundred different plans were presented, out of which a very few were in actual use. As is generally understood, the supposed object of this commission was either to select or cause to be devised what is termed an inclusive system; that is, one which would satisfactorily accommodate the various descriptions of electrical service owned by thirty or more different companies in the city of New York. According to the generally accepted interpretation of the law under which the Commission was appointed, its investigating duties were properly confined to the subject of conduits, through which the various companies are expected to lay such classes of insulated wire as they prefer. Among the vexed questions which continually cropped up was the inductive effect of the arc lighting wires upon those of the telephone and burglar alarm systems more especially, although none of the other interests appeared to regard them as desirable neighbors.

Among the proposed plans of providing for arc light wires were those of imbedding them in a solid prism of insulating material, the individual wires being either bare or insulated; running them through small individual ducts or small glass tubes, making them up in cables, using various descriptions of insulation; but more commonly the individual wires were expected to be insulated, and covered with a sheathing of lead. In the latter form subterranean arc lighting wires are now and have been in use for a considerable length of time in Chicago and Philadelphia.

For underground work, especially cables, it is of vital importance that the conductivity should be ample, and the insulation unquestioned. In both of these particulars it will be found most economical in the end to allow a safe margin. The value of a conductor when once placed in position is sufficient to warrant that no reasonable care or expense should be spared to provide not only against actual damage, but also the annoyance arising from interrupted circuits. It is here that the principal item of additional expense for underground work is to be incurred, for while wire suitable for aerial use in arc lighting costs but about two cents per foot, the price of insulated wire, which may be safely put under ground, ranges from six to twenty-five cents per foot. Without going into the question of ditches, conduits, poles, insulators, etc., in order to obtain a basis for a proper comparison of prices, we are at once confronted with the stubborn fact that the wire alone will cost at least $300 per mile. The various circumstances which will govern subterranean construction in different cities will materially affect the cost of the work. Where conduits are provided by a company organized for that purpose a fixed rental will doubtless be charged and the manner in which the space is utilized and the number of wires for which accommodation is required will have a most important bearing upon the cost pro rata of each circuit. In Chicago a $2\frac{1}{4}$ inch duct is rented for $500 per year, which if required will permit eight arc light wires to be drawn in, each being five-eighths of an inch in diameter outside. It is evident that in cases where individual companies perform their own construction, the proportionate cost of each circuit is considerably reduced as the number of conductors increases. In such cases also, the company doing its own work may choose its own method, while in dealing with a conduit company it is obvious that the facilities offered must be utilized. I have already pointed out the necessarily increased cost of the wire to be used for this work, and it is obvious to all that by the adoption of a conduit which will permit the use of the lowest priced wire, without endangering either the property or the service, there will be a considerable saving in this particular. To accomplish this desirable result the conduit should be of an insulating material, and of sufficient stability to not only protect the wires from mechanical injury, but endure the ravages of time and the disintegrating effect peculiar to the soil arising from either natural or artificial conditions.

While it may be perfectly practicable to insulate arc light wires from the possibility of earth contact, under ground, the difficulty and expense of doing so is materially lessened by the use of an insulating conduit. Upon this question there is an honest difference of opinion between different investigators, some of whom confine their attention to the requirements of the particular branch of service in which they are interested. It being the natural tendency of electricity to seek the earth, it appears wise if compelled to use subterranean wires, to insulate them as effectually as possible at a reasonable expense.

To enter into the merits of the various proposed plans for this character of work would be beyond the province of this report, and invite discussion regarding features which would not be based upon the test of actual experience, and it is therefore confined to brief details of systems with which many of your members are already familiar.

A conduit of cast iron is now used in Philadelphia through which arc lighting wires have been drawn for a system which has been in operation for over two years. Over 250 lamps are said to be used in connection with it. The conductors used are insulated with India rubber, covered with braid and sheathed with lead, the outside diameter being half an inch. This conduit is built in sections with shelves inside to accommodate different classes of wires, although used commercially for electric lighting only. No record is presented regarding the regularity of the service, but it is said to have been perfectly satisfactory.

The conduit system of Chicago, in which various arc lighting wires have been placed, is made of a special form of asphaltum concrete, originally devised for sewer pipe, and according to the testimony of civil engineers who have carefully examined it, is practically indestructible for underground work, although it should be properly protected from the prolonged effect of extreme heat. This material is a good insulator, and it was this qualification which led to its availability for subterranean electrical work. This form of conduit was referred to at your last meeting, and since that time has been introduced in Detroit, where an arc lighting system in connection with it was recently established, which is now in operation.

In Washington, where the Government authorities are forcing the electrical companies to place their wires under ground, no inclusive system has been suggested, but each company is supposed to adopt such a plan as may best suit its requirements. This condition of affairs is liable to arise in cities which are subject to underground enactments, but in which the electrical systems in operation are not sufficiently compact to require a general conduit.

The plan adopted there for arc-lighting wires consists of a wooden trough in which insulated conductors are laid side by side, the wires being separated from each other by the use of bituminous bridges, which are placed about 18 inches apart. The trough is then completely filled with bitumen, making a solid insulating mass, impervious to dampness. With wires of ample conductivity such a plan is no doubt permanent and reliable. The distribution wires are branched out in a similar manner. With a small number of main lines this operation is comparatively simple, and may be readily understood by examining the drawing herewith. [Drawing exhibited.]

An estimate is appended, giving the cost of a 60 arc-light plant, arranged in connection with an underground conduit of this character one mile in length.

Your attention has been directed only to such underground work as has been actually accomplished in this country for arc lighting purposes, with a view to the accumulation of general information which may be of benefit in the future extensions in the industry in which you are engaged. The nature of the subject is such that there will necessarily be many conflicting opinions as to the proper course to be pursued, in which you will naturally be guided by a proper regard for safety, reliability, durability, and economy of construction.

Estimate for sixty-light arc plant with underground systems:

On basis of capital, say	$20,000.00	Underground conduit (one mile in length)	$ 4,000.00
Building	1,000.00	2 mains, 4 wires, including 60 connections, say	17,000.00
Engine and boiler	2,000.00		
2 dynamos, lamps, etc.	10,000.00		

Expenses of running plant would be:

Labor, 1 supt.	$ 2.50 per day	Coal	$3.75 per day
" 1 trimmer	1.50 per day	Sundries	1.00 per day
" engine driver	2.50 per day	Total	$12.75
75 carbons	1.50 per day		

If only 50 lights are used, at 40 cents per night each, it will yield a revenue of $20 per night.

A revenue of	$20.00
Which will have cost	12.75
Leaving a profit of	$7.25
And taking 300 days per annum	2,175.00

or equal, say, to 10¼ per cent, per annum.

If 60 lights are used at 40 cents	$24.00
Cost same as 50 lights	12.75
Leaving a profit of	$11.25
Or taking 300 days per annum	3,375.00

or equal to, say, 16¾ per cent. per annum.

Dr. Moses said that the problem of underground wires in New York has had many difficult features. Subterranean New York was like subterranean Rome, with its steam heaters, its network of gas pipes, sewer system and water system. Any system that could be adopted must be one of combined character. The problem, if solved in New York, would very materially facilitate its solution elsewhere. Mr. De Camp gave his personal experience on the subject.

"We have made a great many experiments," he said, "but all have been failures. Since last November we have put three systems in operation. One soon failed; the other two seemed to work well enough; but I have just received a dispatch from my superintendent informing me that the other two have ceased to operate. We have not been encouraged by the experiments we have made."

Mr. Hotchkiss said: I do not think there is a doubt in the minds of those present as to the fact that wires can be placed under ground and made to work successfully, provided the proper investment is made and the right kind and quality of material is used. But the question whether the investment will be remunerative cannot be regulated by some town in Wisconsin under alogether different conditions from those existing in New York or Baltimore.

Mr. King and other members thought that the conduit system, being of necessity rigid, offered many difficulties, especially in Northern latitudes, while in many places it would be difficult to find room for the conduit.

Mr. Callender insisted on the practicability of underground work, and quoted a great many well-known cases, especially those in which his company had been concerned, not only in Europe, but in the United States. The Callender system had just been put down in New Brunswick for the Edison people, while in Washington it was in extensive use with the United States and Thomson-Houston systems.

Mr. Morrison said: No one would dare in this convention to say that it is impossible to put the wires under ground. It is feasible, but economy stands as a bar to it while men regard it an experimental operation. The fact that a great many wires are under ground settles the question as to its practicability. In Europe most of them are under ground now. We have now in New York a most searching investigation in this direction to adopt the best methods of those already provided. It is unfair to compel men to put their wires under ground until the best method has been settled upon. I have tried two ways. One was to put the bare wires in bitumen. This was done at the City Jail, and the wires operated two or three months. The other way, tried in the same neighborhood, was with a cable. Our position is, we don't want to put our wires under ground in the first place, and in the second place we insist on fair play until this subway commission decides upon a plan. When that time comes, there will be no difficulty from electric light men. The trouble will come from the telegraph men. In Baltimore, the Mayor takes strong ground in favor of underground wires. Sometimes a chief engineer of a fire department speaks of the danger to firemen from overhead wires. That's what our chief engineer has done in his report. None of this talk about accidents from wires to firemen is true. His statements about that are on a par with his statements in other things. He hasn't sense enough to tell the truth, if he knew how. If a city official is so dense, it is pretty near time to put men with more brains and less muscle into the places of the city government.

The following resolution was offered by Mr. Charles Cooper, of Brooklyn:

Resolved, That it be adopted, as the sense of the National Electric Light Association, that up to the present time there has been no system of putting wires underground that recommends itself for adoption by the electric light companies of America, and that unless something more feasible is presented we earnestly protest against any enforcement of the underground system until it is proven beyond doubt that the usefulness or life of the electric light companies is not jeopardized; and that we believe that, up to the present time, all underground systems are more or less experimental, and that it is an injustice to expect the electric light companies to adopt any system that has not proven itself practicable not only in an electrical, but in a commercial sense of the word.

This resolution was referred to a committee of three, who reported later as follows, the resolution being adopted:

Resolved, That it is the sense of this Association that no legislation looking to the placing of wires underground should be enforced until it has been proven beyond doubt that by such an act the usefulness of or life of the electric light companies is not jeopardized; and further that it is the sense of this Association that up to the present time no such underground system has been put in practical operation.

Committee, { CHARLES COOPER, FRANK RIDLON, E. R. WEEKS.

The following paper from Mr. Chas. J. Van Depoele was then read on

ELECTRICAL TRANSMISSION OF POWER.

I appreciate highly the honor you conferred upon me at the last meeting held in New York, in appointing me to make a report with regard to the progress made in the electrical transmission of power, and I only regret not to be able at present to give a more detailed account of what has been done. However, I shall endeavor to show that electrical transmission can be used with economy on ordinary street railways, doing away with horses or with dummy steam engines; and in the absence of other data at command, I will take the liberty to give you my own experience of the past few months, if this may be acceptable to your honorable body.

During the summer months of 1885 I entered into a contract with the directors of the Toronto, Ont., annual exhibition, to run a train of three cars and a motor car from the street railway terminus to the upper grounds of the exposition, a distance of a mile. Having only a single track, I had to prepare here for a light train and good speed. The plant consisted of the following: One steam engine, 10 by 16, running 125 revolutions per minute, driving an ordinary 40-light (arc) machine, having an E. M. F. of about 1,400 volts and an intensity of current of about 18 ampères. The engine and dynamo were placed in Machinery Hall close to the boiler room.

The dynamo was connected, one pole with the rails, which were fastened together by means of fish plates, and the other pole to an overhead wire, hanging over the centre of the track, by means of arms extending from poles placed along the length of the track. On top of the car, on which the motor was placed, was a contact wheel carried by a pivoted beam, the latter being provided with a spring on one end pressing the wheel at the other end up against the underside of the overhead wire. This contact wheel was in communication, by means of a flexible cable, with the switches, rheostat and motor; from the motor the current was carried to the axles of the wheels, the wheels to the track, thus closing the circuit upon the generator.

We began placing poles, etc., on Sept. 1 and made our first trip on Sept. 5. From beginning till end not the slightest hitch occurred, running regularly from 8 A. M. till 10:30 P. M. without stopping a minute. On many occasions we carried from 225 to 250 people. On one end of the track we had a 200 ft. curve to start, then a level of some 2,000 ft., with two curves of about 1,000 ft. radius, then a grade of some 1,500 ft., gaining gradually to about 6 per cent. The rest of the road had a downward grade to the terminus, which made it a disadvantage in starting. As above said, the distance was a mile and the round trip never exceeded 8 minutes, so that including starting and stopping, we made for part of the way at least 30 miles per hour. During the last five days of the fair we carried fifty thousand people. The consumption of coal, as given by Doty & Sons, who ran the engine, was on an average of 1,000 lbs. in 10 hours.

The next step was to South Bend, Ind., where we equipped 4 ordinary street cars, one large open car with a 10 h. p. motor, and the other three closed cars, each with a 5 h. p. motor. The large car was run for the first time on Nov. 14, 1885, and was packed with humanity to its utmost capacity. Everything worked like a charm. The plant consists at present of the following: a 50 h. p. water wheel, and two 20 h. p. generators, and as above stated one 10, and three 5 h. p. motors. The track is laid with the ordinary flat rail, so in order to connect the rails together we placed copper plates 3 in. × 12 in. under the joints and spiked the rails down on both sides of the track, so that there is no chance of breaking circuit. As will be understood the rails in the present case form again one part of the circuit, the other part consists of a copper wire ¼ inch diam. suspended above the track, from cross wires fastened to poles placed near the curbstone, and at a distance of about 100 ft. apart. From the under side of this copper wire or conductor hangs a carriage, fastened to a flexible cable, passing to the inside of the car, where it is in connection with the switches, the motor, etc.; this carriage travels along with the car, and makes a perfect contact. After the first trial of Nov. 14 the 5 h. p. motors were soon in place and have worked admirably. The tracks are never perfectly clean, on account of constant traffic over the road, but since both rails are connected and also all four of the wheels, it is almost impossible to break circuit between the motor and the rails. The cars have run right along through mud and snow, and no trouble has been experienced with the circuit.

On running the four cars at once, the generators work perfectly, from 6 in the morning until 11 P. M., requiring not the slightest attention; the brushes are set in the morning, and are not touched afterward. Every car works independent, back or forward, without interfering with the others, the division of the current leaves nothing to be desired. The only trouble we have encountered with the plant has been with some small mechanical details, such as link-bolts breaking, etc. These, of course, being small matters, are easily remedied. The main point here was the electrical part, and this has proved to be an unqualified success.

The length of the present road is about 2½ miles. The other roads will be equipped as soon as the weather allows of the placing of the poles for the cross wires.

On the 6th day of October, 1885, we entered into a contract with Mr McConnico, President of the New Orleans Exposition, to run a train of cars in the grounds, with a carrying capacity of from 180 to 200 people. This road is similar to the one in Toronto, nearly a mile long, running from St. Charles street main entrance, along the Government buildings through the grounds, to the main building and Art Hall.

All was ready for operation for the opening day, but on account of delay in obtaining steam power, we only began running regularly on the 14th of December.

The heaviest work we have done, so far, is in Minneapolis, Minn., and that during the winter months when snow and ice are faithful companions on the track; whether invited or not, they are there, and never fail.

Before undertaking the job, I was very much afraid that electricity would not be practicable in a climate where the thermometer rises seldom above the freezing point for at least three months of the year. All my fears, however, have been removed in the past six weeks; we have ascended the grades and turned the curves with at least as much facility as the steam dummies.

The electrical plant consists at present of one 60 h. p. generator and a 50 h. p. motor. Our circuit consists of the rails for one side and an overhead copper wire 3-10 inch in diameter for the other side.

In South Bend we have water power as the prime motor. We ran for the first time on New Year's Eve, 1885, and continued on New Year's Day. The water-wheel had no governor and we found it rather dangerous for the generator. As the water wheel had to be governed by hand, it was impossible to keep the speed anywhere near constant. It was decided to put a governor on before running regularly. Several trips, however, were made over the entire length of the road giving entire satisfaction. The weight of motor is 3,500 lbs., and the total weight of motor car or electric locomotive is 8 tons. The passenger cars in use here are similar to those on the New York Elevated. In some instances we had three to four inches of solid ice on the track and broke our way through it without the least trouble; in a few days the water power will be in shape to run regularly, when we will run on schedule time.

Thus far we have demonstrated that electric railroads can be operated anywhere where the steam motor can go, and that there is much in favor of the electric motor in cold countries is very evident; there is no danger of pumps freezing up, nor of brakes becoming inoperative; no water tanks are needed along the road, nor is there any coal to be taken; in fact, there are thousands of advantages in the application of the electric locomotive on street and other railroads. Whenever water power is obtainable the economy need not be disputed, and even in the case where steam is to be used as a prime motor there will be considerable economy.

No cheaper or better plant can be expected to run light trains on suburban roads than the electric motor; as, for instance, in the Detroit road now in progress, connecting the latter city with Dearborn, a single train will be run with six large-sized street cars; the speed will be from 15 to 20 miles an hour, the length of this road is nearly three miles, and it will be in operation in a few weeks.

A similar road will be in operation early in the spring in Appleton, Wis. In this case, however, six cars will be equipped with ten horse-power motors and run independently; the length of road is about eight miles: the speed about 10 miles per hour. Water power will be used to run the generators.

The street railway in Montgomery, Ala., is now being equipped with our motors, 12 cars in all, and will be running within 30 days.

In all the above places we are using overhead conductors, which are no more of an obstruction than the ordinary telegraph and electric light wires; in fact much less, since the conductors are over the centre of the roads, so that wherever wires are allowed for other purposes, they cannot be refused for the present purposes. I do not believe, however, that overhead wires would be practical in large cities where other wires have to be buried; but in this case the electric conductors can be placed underground in conduits similar to those used for cable cars. This will be much more expensive than the overhead conductors, but it will be a permanent and practical fixture.

I feel sorry that I have not found more time to prepare some figures with regard to tests of motors and general transmission, but the above is a *résumé* from practical experience and facts on the track instead of on paper. I am a solid believer in the saying that experience is the best teacher, and to all the above I have attended personally from beginning to end, and am more than ever convinced that the electrical transmission of power has not only ceased to be ephemeral, but has become a real fact and a blessing to the world. All is ready, it has only to be applied judiciously and success is imminent. Thousands of horse-power are now running waste in our water falls which can all be utilized to advantage, in some cases running our tramways, in others our factories, etc., giving at the same time light and cheer during the absence of old Sol.

Mr. Allan V. Garratt then made the following address on

LIGHTING FROM PRIMARY BATTERIES.

When he stood up to advance those principles of astronomical science which since then have given his name a world-wide reputation, Sir John Herschel prefaced his remarks by saying that "every student who enters upon a scientific pursuit, especially if at a somewhat advanced period of life, will find not only that he has much to learn, but also much to unlearn, and as a first preparation, therefore, for the course he is about to commence, he must loosen his hold on all crude and hastily adopted notions, and must strengthen himself by something of an effort and a resolve for the unprejudiced admission of any conclusion which shall appear to be supported by careful observation and logical argument, even should it prove to be of a nature adverse to notions he may have previously formed for himself or taken up without examination on the credit of others. Such an effort is in fact a commencement of that intellectual discipline which forms one of the most important ends of all science."

I need not tell you, gentlemen, that I have not come here to warn you against forming crude and hastily adopted notions in regard to the electrical system which I represent, for I believe that the electric light companies of this country are represented by men who do not jump hastily at conclusions, and who are not in the habit of taking things for granted; but I ask you in all fairness not to unthinkingly class our system of lighting with those inventions which periodically appear before the public with meteor-like brilliancy, claiming to do that which every scientist knows to be impossible with the materials at their disposal; companies whose exodus from the business arena is as sudden and to the uninitiated as unexpected as their advent, and in regard to whose end we must remain silent if we wish to be charitable.

Had it not been for the scholarly paper (by Dr. Moses) to which we had the pleasure of listening yesterday morning, I had intended to speak in detail of those early experiments with the voltaic current; experiments beginning with Professor Volta, of Pavia, in the year 1800, when he constructed his electric pile, followed by his *couronne de tasses*, or crown of cups, which suggested to Sir Humphrey Davy his brilliant experiment of the same year, when he dazzled the whole world by producing for the first time the electric arc. These experiments were followed by others so numerous that were I even to enumerate them, I am sure I should be imposing upon your patience. It is sufficient to say that in the years which followed, a few scientists, conspicuous among whom were Daniell, Grove, Smee, Bunsen, and Poggendorf, won for themselves renown which is historic.

I need not remind you that there are especial points of activity and stagnation in the history of all science, and that at about the middle of the present century electricians had well-nigh abandoned the hope of producing powerful and continuous currents of electricity by primary batteries, and the attention of electrical investigators was turned more especially to the theory of electromagnetic induction, as advanced by Faraday as early as 1831, after which followed many inventions, conspicuous among which were those of Pixii, Pacinotti, Siemens, Wheatstone and Gramme; and in this way the whole question of producing powerful currents of electricity by purely chemical means fell into the background and became looked upon as a thing of the past, and the problem of converting the heat which accompanies the rapid oxidation of fuel into motion, and from motion into electricity, became the absorbing question of the day.

The latter half of the present decade has, however, marked an epoch of remarkable activity and interest in the subject of producing powerful electric currents by primary batteries, and electricians are now working actively on this question.

In the present state of the art it is not becoming in any man to stand upon the floor of this convention and claim to do with a primary battery that which can be done with a good dynamo machine; but, as you know right well, the question is not always, how much electric light can you produce within economic figures, but you are often times

asked, how little light can you furnish from an isolated plant at a price which consumers will pay?

This is precisely the question which I am prepared to answer. A primary battery capable of successfully lighting for a number of hundred hours a single incandescent lamp, or, if necessary, a score of them, is not an invention to be put aside as wholly insignificant.

I speak conservatively when I say that it makes not only possible, but feasible, the electric lighting of a single house, a yacht, a parlor or sleeping car, or even a man's own private carriage It also places at the disposal of every physician and surgeon a light always ready and requiring but little care, with which he can explore the interior of the human body. I need not suggest other uses for such a light; they suggest themselves to every one. This is a field of electric lighting which is out of the reach of the dynamo machine.

The Chemical Electric Light and Power Company, of Boston, of which I am the representative, is to-day putting out plants for the purposes which I have enumerated. It controls by letters patent the use in a voltaic battery of those chemicals which alone make possible practical results.

Heretofore a battery which could maintain an electric light for twenty hours was looked upon as phenomenal. The Chemical Electric Light and Power Company have placed a plant in the New York Mutual Life Insurance Building of Boston, which gives the elevator car 300 hours of good light with one charge of battery solution. We are furnishing light at prices which we find the consumers are willing to pay.

I have intentionally refrained from going into the details of construction of our battery, or the composition of our solutions. I should not feel justified in occupying the floor of this convention for any such purpose. I wish simply to say that we have no secrets, and the structure of our battery and the chemicals which we use are at all times open to inspection. The time has gone by for any one to claim to produce electricity or electric light for the public in any way which does not appeal to the good judgment and common sense of practical men who are skilled in this particular branch of applied science.

I will not longer take your time with this matter.

In closing, I wish to say that it has been to me a pleasure to bring befor the National Electric Light Association the first practical device for producing the electric light in commercial quantities and within economic figures, by purely chemical means, without the intervention of any mechanical force whatever.

A committee, consisting of A. J. De Camp, R. W. Pope and Charles Stewart were then appointed to consider the legal relations of electric light companies to insurance, the public and the Patent Office.

Adjourned.

At the opening of the morning session Friday, 12th inst., the following was presented and adopted:

The committee appointed offers the following substitute for Article IV.:

The officers of this Association shall be a President, two Vice-Presidents, a Secretary, Treasurer and six members as an executive committee, four of whom shall constitute a quorum.

All officers shall be elected by ballot for one year, or until their successors be elected and qualified, except the Secretary, who shall be appointed by the President. All vacancies to be filled by the Executive Committee.

A letter was read from Mr. Geo. S. Bowen, regretting his inability to be present.

Mr. E. R. Weeks then read a paper on

OPERATING EXPENSES.

Were it possible to make an estimate of operating expenses, that would be an average for all parts of the country, and for various plants, the result would be of comparatively little value. Conditions are so different that exactly the same plant would require a much larger expenditure in one locality than in another. Water-power may be available in one city, and the operating expense of the power department be reduced to an inconsiderable amount. Again, proximity to fuel supplies will give this item a subordinate place. The wide differences in the size of plants do not make a corresponding difference in expenses; even in a given plant, an increase in the number of lamps does not equally affect the expense in all departments, nor is the change in operating expenses in direct ratio to the increase. A plant of incandescent lights does not give the same relative per cent. of expenditure for lamps and for power as obtains in an arc plant; the single item of attendance in the lamp department being much less for the former.

In making an estimate of operating expenses, therefore, it has been thought best to take as a basis an arc plant of two hundred lamps, and leave as much margin as possible for the varying conditions which affect the cost of labor and supplies.

As water power is available in few cases, it has not been considered, this report being based upon the supposition that most plants must be operated by steam, which necessitates large expenditures for machinery, fuel and attendance, and renders the question of economic measures highly important both to the furnisher of light and its consumer.

In establishing a plant, two items enter into the calculation of financial returns—the original cost of machinery and the expense of running it.

In no other business does so close a relation exist between the quality of machinery, the operating expenses and the net gain. In other industries it pays to buy the best implements; in electric lighting anything else is a loss. Reliability is the first consideration. It is not necessary to say to a body of electric men that stoppage means rebate, rebate means loss, not only in immediate returns, but in confidence from customers, and, so, greater financial loss.

Every piece of machinery should be chosen, not with reference to its price, but to the dependence that can be placed upon its steady, efficient service. The best engine is not good enough. Many a lighting plant has failed because of a poor one. There should be an automatic cut-off, and all bearings should be large and strong; the governor should be perfect, so that a change in load shall not result in a change in speed, and a consequent variation in the lights. If given its maximum load, a large engine is much more economical than a number of small ones; but in case of stoppage the loss increases in proportion to the number of lights.

Economy requires a fair grade of oil freely used. Heated bearings result equally from the clogging of poor oil, and the stinted use of a good one, and they necessitate stops with a consequent loss of time and its aggravating train of results. The seeming waste from a free use of oil may be prevented by a system of drainage, which will preserve the drip, to be used over again, and finally to be sold

Where the water is full of impurities, *special* attention must be given to the construction of the boiler, which should be such as to allow a free circulation, and render all parts easy of access. The *best* boilers require frequent cleanings, with thorough inspection at least once every three months. Heaters should be of such design, grates of such pattern, and all steam apparatus so set up and adjusted as to allow the use of the lowest grades of fuel in the most economic way. Fuel being a heavy item of expense, an attentive fireman, capable of intelligent judgment as to the greatest amount of heat to be obtained from a given quantity of fuel, is a profitable investment. Two dollars per day is but value received for the services of such a man. In a two hundred arc plant he can save more than his salary, and, in addition, can produce from a cheap grade of coal better results than can be gained by the ignorant use of the most costly fuel.

As was plainly shown at our last convention, the cost of fuel is a widely varying item; one, indeed, upon which there seems to be no common ground except the desire to reduce it. According to the varying grades and the different methods of handling, from three to fourteen pounds of coal per lamp per hour are required; and its price ranges from $3.50 to $0.50 per ton.

As the most efficient service demands the closest attention on the part of engineer and fireman, too long a watch should not be required.

Basing our calculations upon a good mixture of slack and nut coal for a 200 arc plant at an average distance from the fuel supply, the cost of the power department should be not far from 32 per cent. of the whole operating expense.

Even with the most carefully-constructed lines, having supports not over 100 feet apart, inspection of the whole circuit should be made every two or three days, especially in cities where there are narrow streets or a great number of wires. A good line foreman is worth from $15 to $20 per week, and he should keep his department within 7 per cent. of the total operating expenses.

Economy requires an absolutely automatic regulation of the current; and the most satisfactory service will be secured when the tension is not too high. The object sought should be, not the greatest amount of light on a given circuit, but the greatest amount consistent with a reasonable degree of safety.

Several years of experience seem to have demonstrated that a light, double-leather endless belt without rivets is best, giving the greatest security against stoppage, and a steadier pull for the machine than results from other kinds of belting. In the care of dynamos, cleanliness cannot be too rigidly exacted. *Cleanliness* here is the watchword, not only of success, but of true economy. A neat, rapid and observant attendant is absolutely necessary, that trouble and expense may be avoided. To prevent costly delays, all bushings, insulations, etc., should be cleaned daily; frequent inspection of their condition should be made, and they should be found in a state that would leave the white kids of a West Point Inspector free from the slightest stain.

The cost of the running of the dynamo department should form about 14 per cent. of the whole operating expense.

Single lamps with larger carbons, even when they must be re-trimmed during service, are more economical than the duplex lamps. The globes used on the latter are more expensive and are more frequently broken. The unequal expansion produced by heating the side adjacent to the arc and the sudden change in temperature from the shifting of the arc to the other side, always lead to this result in double lamps. The loss on them in this direction alone, would almost pay for the extra service of retrimming single lamps. Moreover, owing to the crowded condition of the box of the duplex lamp, it is more apt to get out of order; and, for the same reason, is more difficult to readjust; and, as carbons are not uniform in their lasting qualities, the loss from burnt holders reaches its maximum where this lamp is used.

Outside lights give more reliable service when hung rigidly, and the same is true for inside lamps, unless a device similar to that exhibited at Chicago by the Western Electric Company be used. Light, hard wood ladders and a good lamp man, will have a better effect upon operating expenses than the ordinary loose tackle for raising and lowering. The ladder is, of course, less convenient, but a lamp properly trimmed with it is in no danger from the frequent variable contacts caused by raising.

In the use of carbons, a certain amount of waste must always result; but this item can be considerably reduced by trimming short time lamps with pieces. The carbon question properly belongs to another committee, but it may be said here that cheap grades are a constant source of annoyance and loss.

Globes are a vexatious part of the best lamps, and swell the item of breakage despite the utmost care. In fact, there is no profit in them, except for the manufacturer. Nine-tenths of this breakage is due to the unequal expansion resulting from over-heating. The most feasible of the proposed preventive measures would be the use of a sheet of asbestos packing, which would insulate the globe from the undue heat at the lamp-base.

Perfect trimming of lamps, as early as possible in the day, should be insisted upon. Switches, bases and all contacts must be well cleaned. Rods should be wiped before being pushed up, and in scouring them, nothing but crocus cloth should be used: In exposed places, they should also be provided with protectors. All screws and contacts must be kept tight. A careful lamp man without patrol duty can trim 100 lamps per day, while for one who patrols his own circuit from 25 to 50, according to distribution and service, is a reasonable number. Such men are worth at least $1.50 per day.

With reference to the lamp department, there should be a thorough system of, at least, fortnightly inspection, with reports of trouble and breakage, and their causes.

With careful attention, the expense in the lamp department should not amount to more than 28 per cent. of the operating expenses.

As the cost of installation and attendance is generally borne by those manufacturing light, as all fixtures are usually furnished by them, and as the change in seasons produces but slight variations in operating expenses, it is only fair to ask that the revenue be equally uniform. Hence contracts should be annual; circuits should not be cut for transient business without adequate compensation. This is difficult to fix, but it should be at least one-third more per month than the yearly rate.

We do not offer this paper as a satisfactory or comprehensive report on operating expenses. Data upon which to found estimates of real value have not been accessible, owing to an evident reluctance to make them known. The subject is, however, one of the most important that can occupy our attention. Upon it chiefly depends the future spread and financial success of electric lighting. Our business is new, and its operation so different from that of other industries that we cannot draw largely from their experience. At the same time, the public is no longer so patient of slow and awkward experiments at its expense as it was in the early days of telegraphy. People demand immediate perfection in the thing for which they pay.

It therefore behooves each one of our members to give freely and fully of his experience to our common fund of knowledge, that our industry may gain a sure and substantial paying basis in the shortest time possible. We would therefore suggest that a standing committee be appointed to receive statistics in regard to the various operating expenses; that this committee adopt a form of blank analysis to be furnished to each member of the association, whose personal duty it shall be to fill out such blanks monthly, and forward them to the chairman of the standing committee; that this committee compile and present to the annual convention of this association general statements as to the operating expenses of various plants, both arc and incandescent. This information should, of course, be received by the committee in perfect confidence, and should be used only for the benefit of members of the association.

There are many ways in which our interests might thus be promoted. For instance, it may appear that A, running a 300-light plant, has an expense of 2 cents per lamp per hour in the lamp department (repairs, globes, carbons and attendance); whereas, that of B, with a business of like extent, amounts to 2, 3 or 4 cents, and in the power department A may be spending 3 and B but 2 cents per lamp per hour. The chairman would then direct A to confer with B in regard to power, and B to correspond with A in reference to the lamp department.

Unless some such method be adopted, any treatment of the subject will be of little value; while, with such a system, reports could not fail of most important beneficial results.

Dr. Moses then made a very interesting address in review of the development of electric lighting, especially as regarded incandescent lamps, and summed up by expressing the opinion that in the incandescent lamp one desideratum was to get filaments of greater size, without increasing the size of the globe, as the vacuum was costly to obtain in proportion to the number of foot-pounds of energy expended. In a word, the filament should be larger than the orifice through which it was introduced. He said he had been working in this direction, and he then showed a lamp of small spherical globe in which unusual length had been attained by doubling the filament back on itself so as to assume a shape not unlike the letter J herewith.

Lieutenant Duncan then gave some information as to the Franklin Institute tests, as already reported exhaustively in these columns.

In response to a remark by Dr. Moses on these tests, Mr. Martin stated that a very full reply to criticisms on that work, from President Tatham of the Institute, had already been published in THE ELECTRICAL WORLD.

Mr. Robinson asked for information as to the known effect of reversal of poles in the lamps.

Dr. Moses knew of no detrimental effect.

Mr. Smith, of Jamestown, N. Y., stated that he had found trouble in running the incandescent lamps on arc circuits. The lamps did not last as long.

Mr. Upton said that the general opinion among New England electric light men was that the practice was not altogether a success.

Professor Rowland, who had previously invited the members to visit Johns Hopkins University, announced that he was experimenting on the cause of globe blackening in incandescent lamps.

A discussion here arose as to the condition of carbon at high temperatures. Returning to the subject, Mr. De Camp said that in Philadelphia incandescents on arc circuits were not a success at present. He thought it was a craze which must be met, but that its novelty would wear off. It appeared from other remarks that in Baltimore the system was being pushed with very good success. Mr. De Camp, of Philadelphia, said it was the cause of great activity among lamp makers. Dr. Moses figured out on a hypothetical case that the cost of eight incandescent lights, 16 candle-power, burning 11½ hours, was 70 cents; while the same number of gas jets, burning the same time, would cost 75 cents. Hence he held the thing could be done with profit. Mr. De Camp suggested that perhaps the thing might be done with such a lamp as the Bernstein, each having its separate resistance box, with a companion lamp to cut into circuit should the one burning give out.

Mr. Rorison asked some pertinent questions as to the relation of efficiency at high temperature to duration of the lamp in practice, but succeeded in eliciting only general statements.

Mr. Frank Ridlon then read a paper on

CARBONS AND GLOBES.

The following is suggested as a perfectly fair carbon test: Take a dynamo machine, with its full complement of lamps, and trim the lamps with the same make of carbons; note the speed of the dynamo carefully, and during the test measure the current at frequent intervals with an ammeter; see that all the lamps burn freely, without hissing, and yet not with arcs so long as to flame. Measure the E. M. F. around each arc with a voltmeter. Burn the lamps until all the carbons are consumed, or burn them, say, for four hours, and then measure the length of carbons consumed, and calculate the total time that they would burn, taking the average result.

In testing another make of carbon, pursue the same course. You will now be able to note the difference between various grades of carbons. Some carbons will be soft, and will consume so rapidly as to make them uneconomical; others will be of such high resistance that the machine will not run its full complement of lamps with good long arcs, without increasing its speed. In such a case, a lamp or two could be cut out of the circuit until the arcs are normal, and this would show the degree of economy of the first carbons over the others. It is not infrequently the custom to mix several different brands of carbons on the same circuit of lamps, and then judge of the results entirely by the length of time each carbon burns Nothing could be further from a real test. A carbon which would burn nine hours

would frequently be less economical than a carbon burning eight hours; as generally the latter carbon would enable you to burn, say, two more lamps on a 30-light circuit than the former. Calculating the rental receipts from these two lamps, it would be found that they would more than make up the difference due to the more rapid consumption of the eight-hour carbons.

The reason for measurements of current and E. M. F. is obvious, as the resistance of the carbons will affect both. With the dynamo machine running at the same speed, one carbon will give you good steady arcs of, say, 45 volts each, while another carbon will perhaps cut down the E. M. F. to 42 volts, and the lamp will hiss and sputter.

In any case it would not be a fair test to trim part of the lamps of the circuit with one carbon, and part with another, unless it were previously determined that the two brands of carbons were of about the same resistance.

Mr. Ridlon added his opinion that it was desirable to have the carbons better assorted. The "firsts" had too many "seconds" among them.

Mr. Morrison said that, thanks to competition, carbons had been reduced from $66.50 per thousand to $10. He had had satisfactory results from carbons of all the makes. In Baltimore they took care not to mix up the different carbons in the same circuit. That would not be fair play, anyhow. Besides, defects in lamps might sometimes be put to the discredit of the carbons. As to globes, they had bought from almost everybody, but chiefly from the New England Glass Works, and had had very good results with them. In fact, they had been fairly fortunate with globes in Baltimore.

Mr. Ridlon remarked that the trouble from defective carbons made a considerable difference in the receipts at the end of the month for light sold. The deduction for failure would thus sometimes bring the price up again near the old figure of $66.50.

Mr. Cooper suggested the appointment of a committee to standardize the quality of "firsts."

Mr. Fishback said he believed manufacturers were prepared to do the fair thing. If an electric company taking 50,000 or 100,000 carbons would not pay the price for first-class, it put the manufacturer in a disadvantageous position, however much he was disposed to act squarely.

On motion, a committee was appointed to investigate the carbon question, with a view to establishing a standard test to decide the quality of carbons. The committee appointed consisted of Messrs. Cooper, of Brooklyn; Ridlon, of Boston, and King, of Minneapolis. The meeting then adjourned.

On assembling for the afternoon meeting, a communication was read from Mr. W. F. Swift, secretary of the Brush Electric Company, proposing Cleveland as the place at which to hold the next meeting. In connection with this matter, the following was offered by Mr. Fitzgerald, of the Detroit Brush Company, and adopted:

Whereas, the last two meetings of the N. E. L. A. have been held in the East, and as the time of the next meeting is in the month of August, therefore

Resolved, That the Executive Committee be requested to call the next meeting in Detroit.

The following was adopted unanimously:

Resolved, That this Association sincerely mourns the death of Mr. A. J. Holt, of Cleveland, Ohio, a highly esteemed and capable member, whose intelligent work, had he lived, would have been of great value and interest to this Association.

On motion of Mr. De Camp, the following was adopted:

Resolved, That the Chair appoint a special committee, to be composed, as far as practicable, of the representatives of each system, to consider the relations of the sub-companies to their respective parent companies, to act in conjunction with any existing committee, which may aid them in harmonizing any differences that may arise and bring about a more hearty co-operation, so much to be desired and so essential to the welfare of all concerned.

The following was presented:

Resolved, That the new standard English gauge, as officially adopted by the National Telephone Exchange Association, be and is hereby approved by the National Electric Light Association for the purpose of securing uniformity in the mutual understanding of orders between manufacturers, dealers and consumers of wire for electrical purposes.

Resolved, That the associate members of this association engaged in the manufacture and sale of wire be requested to incorporate into their catalogues and price-lists the stipulation that the standard gauge approved by the above association be understood as applying to all orders, unless otherwise specified, either in quoting prices or shipment.

CHARLES COOPER,
RALPH W. POPE,
OTTO A. MOSES,
} Committee.

Adopted and committee continued, with the following instructions:

Resolved, That this committee or its successor be empowered and requested to confer with other associations similarly interested, with a view to the legalizing by Congress of such standard gauge for guidance in the preparation and enforcement of contracts.

Mr. C. J. H. Woodbury then read an important paper on

THE RELATIONS OF ELECTRIC LIGHT COMPANIES TO INSURANCE.

One of the elements naturally disregarded at the outset in the rush to invent, make and install the apparatus, was the possibility that electricity might, like other methods of lighting, become a cause of fire.

Soon numerous fires served as a reminder that electricity as applied at that time, possessed no immunity from consequences similar to those resulting from other methods of illumination, and public opinion for a time had a tendency to veer to an extreme position; even farther from the truth than its first assumption that electricity could not produce a fire.

A careful examination of the circumstances attending a number of these fires and a repetition of these conditions upon electric lighting plants served as the basis of the regulations for the use of Electric Lighting Apparatus, prepared by the writer for the Factory Mutual Insurance Companies, a little more than four years ago. It would have been impossible for the work to have been carried on had I not received the most cordial coöperation from the electric light companies; and the electricians at the head of these companies freely gave of their experience, in the endeavor to determine the facts at issue.

The results of this work warranted the opinion that a well-arranged electric lighting plant was the safest method of illumination, and the experience of time has sustained that position.

The essentials for safety in an electric lighting plant are few and simple. In the presence of combustible material, arc lights should be inclosed in globes resting on closed stands with a raised edge, confining the sparks and copper, and some extra stop at the bottom of the lamp to prevent the lower carbon from falling in any contingency. The feeding apparatus at the lamp should prevent the formation of an undue arc in case of any disarrangement. Switches should be constructed so that an arc could not be formed by their use. The electricity must be confined to its metallic circuits and the conditions of its use controlled.

The regulations found necessary to specify these particulars in detail are of some length, but do not embody any other features. Experience has shown that they have served the purpose for which they were intended, for I do not know of any fire from electric lighting apparatus except where they have been violated.

The chief elements of danger are conductors of high resistance, generally formed by two earth contacts, and sometimes by a conductor between two wires of different potential. Such diversions of current are generally caused by water penetrating the insulation, and it is of importance that the insulation be waterproof, wherever there is liability of exposure to moisture.

Careful attention should be given to the importance of daily tests for ground connections; and for this purpose an ordinary bell magneto is the most convenient apparatus. The electric bells and small galvanometers with low resistance coils frequently used for this purpose, are not sufficiently delicate, as they cannot indicate a weakness in the insulation, unless its resistance be less than ten to one hundred ohms according to circumstances.

The value of this method of inspection which I have described is shown by the results following its adoption. In the autumn of 1881 and winter of 1882, 23 fires were caused by 61 electric lighting plants in mills insured by the Factory Mutual Insurance Companies in the Eastern portion of the United States. The apparatus was inspected and the alterations necessary for safety specified and carried into effect, and there has not been a single fire from electric lighting apparatus on this property since that time, although the number of mills using electric lights has increased to nearly 200, and the average size of the plants greatly enlarged. From being a legitimate cause of apprehension on the part of the underwriters, the hazard of electric lighting, in this field at least, has subsided into a matter of routine inspection.

There is a prospect of new matter at issue, which will tend to reverse the present conditions relative to safety in connection with the distribution of electric lighting. There is a widespread feeling of opposition to aerial electric wires, and several city governments with the intrepidity of practical politicians have passed ordinances decreeing that the wires must be buried.

It is well known that the use of all underground electrical conductors is attended with special difficulties.

The few instances where wires over buildings interfered with ladders of the fire department might have been avoidable by the further elevation of the wires or by their crossing the streets at nearly right angles. In the natural course of improvement the lines in cities are being changed from their scattered courses and systematized upon permanent fixtures high enough to carry the wires a reasonable distance above all roofs. Aërial wires certainly furnish the most ready means for electric companies to reach their customers, who are frequently distributed very unevenly over a city, and like all other seekers after trade, may at times conflict with other interests.

The network of wires over cities serves as the most efficient protection against lightning—these conductors, by their great number, scattering the force of thunderbolts and conducting them to earth; on this account thunder-storms are much more destructive in the country than in cities.

As for personal danger, a lineman is in infinitely greater danger from gravity than from electricity.

I repeat that most of the fires from arc lighting systems have resulted in the diversion of the current by two contacts, one of them being a ground which had existed for an unknown time and the second being an accidental ground, generally of increasing resistance, until it converted the electricity into heat whose temperature was high enough to ignite combustible material. When a ground exists anywhere on a circuit, this ground is trying to form a second connection at the weakest point in the insulation anywhere on the whole circuit, irrespective of position. The one connection to earth may exist near the dynamo and the other in some building at the extreme portion of the circuit, or it may be only a few inches away.

Many underground arc lighting circuits have received faithful trials without obtaining satisfactory results which would warrant their adoption by any form of American practice.

In Philadelphia, the escapes from an underground system of electric arc-light wires on Chestnut street are believed to have been the cause of several severe explosions of illuminating gas leaking through the ground. On Delaware avenue, in the same city, an underground circuit with different insulation received a careful trial, until the escapes through defective insulation, in spite of numerous repairs, diverted so much of the electricity from the circuit that the lights could not be maintained and aerial wires were substituted. The temperature of these escapes was so great that the sand was partially fused in places, and if the lights had been inside of buildings there would have been a liability of such points of excessive heat occurring in the presence of combustible material with destructive consequences.

The result of a few weeks' experience with a short underground circuit is no measure of its capacity to fulfill the requirements necessary for central station arc lighting, as it requires time to develop the faults in such conductors.

In conclusion, it may be said:

1. That the present application of electricity forms a relatively safe method of lighting.

2. Underground wires connecting lighting currents contain elements of serious danger in proportion to their defects of insulation.

3. The compulsory burial of all electric wires would be oppressive to the electric interests.

Our methods of life are so closely interwoven with the uses of electricity that we are dependent upon its applications, especially to transmission of speech, telegraphy and illumination, and any interference with the legitimate exercise of those interests will not be measured by the impaired value of plant or load of excessive expenditures, but will be a detriment to each member of the community now benefited by its use.

Mr. W. S. Wilkinson and Gen. James M. Anderson, underwriters, of Baltimore, expressed their satisfaction with what Mr. Woodbury had said on the subject of safety. Gen. Anderson said that as far as the Baltimore underwriters are concerned they are completely in the hands of the electric-light men so far as such lights are concerned, since there is no official inspection made there as in other cities. There had been comparatively few fires there from electricity, and he regarded it as quite as safe, if not safer, than gas lights. The electric light was used on the Bay Line steamers, and it had given more satisfaction than gas.

Mr. Gilbert then called the attention of the Association to the circular recently issued by himself and Mr. English (printed in THE ELECTRICAL WORLD of Jan. 30) advocating the formation of a mutual fire insurance company among electric lighting companies so as to secure much lower rates of insurance. He said that returns already in from 31 cities or plants showed a total of property liable to destruction in case of fire of $1,171,000, covered by $481,000 insurance, the premiums paid averaging from ¼ per cent. up to 4 per cent., with a total of premium paid for three years of $119,112 on a total loss amounting to about $1,000; that was seven-tenths of a mill on the amount insured. Yet the property was often rated as extra hazardous. He believed there would be in the United States now to insure about $5,000,000 and in five years' time the amount would be trebled. Another argument he presented was that it would help sub-companies to secure repairs from parent companies at a price nearer the actual cost, or else would help them "fit up a hospital for their own work."

Mr. Cleveland supported the movement warmly, as highly proper and desirable, and offered a resolution endorsing the plan in the name of the association.

Mr. Morrison objected very strenuously to any action of the kind.

Mr. Linnell instanced Richmond where his company was refused insurance by six companies, and to-day they were insured at the high rate of 1½ per cent. He was in favor of the plan proposed.

Mr. Woodbury described the well-known and favorable experience of the New England manufacturers' mutuals, but it seemed to him that the functions of the meeting were merely advisory, perhaps commendatory in such a matter. Whatever was done must be done by the individual action of some of them.

Mr. Renshaw complained of the difficulty in getting reasonable insurance on their station in Washington, and approved the scheme of organization.

Mr. King was in favor. They were paying 1¼ per cent. in Minneapolis, and would like to reduce it if possible.

Mr. Gilbert said that the average rate of the 31 reports was 1.65 per cent. He held that the lowering of the rate of insurance meant that they would be able to furnish light cheaper.

Mr. Weeks said that they had paid 3.10 in Kansas City, but as it was not a living rate, had kicked and got it down to 1.45.

After further discussion, the following was agreed to:

Resolved, That this association indorse the plan of an organization of a Mutual Electric Light Insurance Company.

Mr. Morrison voted in the negative. Mr. Rorison inquired whether Mr. Morrison wished to be taken as holding that the resolution was unconstitutional. Mr. Morrison replied that he was not to be so understood.

On motion of Mr. Weeks, the constitution was amended, placing seven instead of six members on the Executive Committee, it being desirable to have an uneven number.

Officers for the ensuing year were elected as follows: President, J. Frank Morrison, of Baltimore; vice-presidents, H. M. Cleveland, Hartford, Conn.; E. R. Weeks, of Kansas City; treasurer, Charles Cooper, Brooklyn, N. Y.; executive committee, George S. Bowen, Chicago; Joseph A. Corby, St. Joseph, Mo.; Frank Ridlon, Boston; George F. Fletcher, Dayton, O.; E. T. Lynch, Jr., New York; Dr. Otto A. Moses, New York; A. J. De Camp, Philadelphia.

Mr. Ridlon proposed the establishment of a Bureau of Information on matters interesting to members of the Association. Agreed to.

Mr. Maher, of Albany, then made a statement as to the manner in which an attempt had been made to cut his company out of the public lighting in that city. He now held the contract, but felt very much hurt at the competition, alleging that his rivals could not have put in their plant in time to do the work had they carried off the contract.

Mr. Cleveland expressed his sympathy with Mr. Maher under the circumstances, and deprecated indulgence in the "cut-throat" business of that character. He did not mean that there should be no competition, but he thought it an outrage when one company had begun business, was doing good work and was paying fair dividends for another company to come in and ruin that business as well as lose its own money. The company doing that sort of thing was dishonorable. He hoped that the Association would sit down on all such enterprises.

Mr. Cooper complained of similar rivalry in Brooklyn, where he considered his company to be meeting all the active or real demand satisfactorily. Mr. Weeks spoke of recent experience of the kind in Kansas City. The discussion then went on with some rattling personalities, but no decision was arrived at as to the best means of preventing competition, except, perhaps, uniformity of rates.

Mr. Ridlon, from the committee on carbons, said:

This committee recommends the following as the standard test of carbons:

Take a dynamo machine, with its full complement of lamps, and trim the lamps with the same make of carbons; note the speed of the dynamo carefully, and during the test measure the current at frequent intervals with an ammeter; see that all the lamps burn freely, without hissing, and yet not with so long arcs as to flame. Measure the E. M. F. around each arc with a volt meter. Burn the lamps until all the carbons are consumed, or burn them, say, for four hours, and then measure the length of carbons consumed, and calculate the total time that they would burn, taking the average result.

Adopted.

A committee of ways and means was then appointed by the chair.

On motion of Dr. Moses, Marcel Deprez, Dr. Cornelius Herz and Baron Alphonse de Rothschild, as being prominently connected with experiments in the great question of the day of the efficient transmission of power electrically, were made honorary members.

The Association then adjourned to meet at Detroit in August.

THE EXHIBITS.

Contrary to usual custom the various electrical supply companies made little display of their goods, but they entertained their friends in a truly hospitable manner.

KERITE.

Mr. Clark B. Hotchkiss exhibited a number of samples of Day's Kerite and lead covered wires, also some fine specimens of armored cables for submarine use.

The samples of 7, 10 and 18 conductor electric light cables for underground use attracted much attention.

THE AMERICAN ELECTRICAL WORKS,

of Providence, R. I., represented by Col. George L. Beetle, displayed a complete assortment of all kinds of wire, from fine magnet to the heaviest electric light wires, in various styles of insulation.

THE NEW ENGLAND GLASS WORKS,

of Boston, was represented by Mr. E. D. Libbey, and showed some of their higher grades of electric light globes and shades, both plain and ornamental, for arc and incandescent lamps.

THE NEW ENGLAND BUTT COMPANY,

of Providence, R. I., made an interesting exhibit of their braiding and winding machines, consisting of a single winder for covering magnet wire with silk; also a double winder for the same purpose, a 24-strand single braider, a 16 and 24-strand double braider, made expressly for covering telephone and electric light wire, and a 24 and 36-strand double braider, which is used on large wires requiring a thick covering. Mr. H. N. Fenner, of the N. E. Butt Company, looked after the interests of his company.

THE NEW YORK INSULATED WIRE COMPANY,

of New York and Boston, had a well-arranged assortment of the Grimshaw insulated wires and cables for aerial, office, underground and submarine use. Mr. W. B. Dowse was the representative of this company.

THE CALLENDER INSULATING & WATERPROOFING COMPANY

was represented by Messrs. W. M. Callender, C. M. Thompson and A. C. Shaw, and exhibited specimens of electric light wires and cables for under ground and under water, a new insulated house wire, and sections of conduits, with wires, as recently laid in Washington, D. C., and New Brunswick, N. J. A new hard vulcanized material suitable for insulating bearings of electrical machines was also shown by this company.

THE MINNEAPOLIS (MINN.) ELECTRIC SUPPLY COMPANY

showed a new glass insulator, with attachment for ceilings and side walls. A screw is attached to the insulator, making it a very convenient article.

M'INTIRE'S

new patent joints and connectors for all kinds of wire were shown by their patentee.

THE OKONITE COMPANY

of New York exhibited some fine specimens of their products for electric lighting, consisting of electric light wires with okonite insulation. Among the samples were 0000 A. W. G. braided, for use in conduits; also double conductors of No. 00, 4 and 6 insulated and double armored for laying directly in the ground. The company claim that by the use of this cable the necessity for digging deep trenches is obviated, and that the expense for laying wires underground is much lightened. It is further claimed that with this cable the wires need not be placed below the frost line.

A new style of insulated wire for incandescent house lighting was shown by the Okonite Company, which the company claim can be placed right in the mortar without injurious effects to the insulation, thereby avoiding the use of tubing.

THE BROWN ELECTRIC COMPANY,

of Chicago, exhibited a new automatic apparatus for use in operating incandescent lamps in arc circuits. This instrument receives the high tension current and "converts" it into a safe low tension current suitable for the incandescent lamps. It is built for all different styles of arc light generators, and can be used with any make of incandescent lamps of the proper resistance. The number of lamps in the group is, of course, determined by the kind of current produced by the generator used and the amount of current required by each incandescent lamp. Any of the lamps may be extinguished or lighted at will, as the automatic converter will deliver no more than the current necessary to maintain the number of lamps which happen to be burning, and is almost instantaneous in its action. When the generator is stopped the automatic converter at once sets itself in position to deliver less than the current required for one lamp, so that if any lamps are disconnected or broken when no current is flowing, those remaining will not be injured or destroyed when the generator again starts. The mechanism of the automatic converter is extremely simple, and after being once properly connected and adjusted needs little or no further care, as its working depends on the strength of the current and the attraction of gravitation, no springs being used. There is no danger of destroying the resistance used in the converter, as it is constant and cannot be broken or injured by heat, and there is no friction or sparking as the apparatus works. When it needs attention it will *show* that it does, by failing to turn on the lights or by extinguishing them.

ECHOES OF THE CONVENTION.

One of the most popular members of the association is Mr. Charles Cooper, of Brooklyn, who is again elected treasurer. He was on this occasion accompanied by his young wife, being the only benedict thus cheered. Mrs. Cooper attended the meetings, and so won the hearts of some of the more impressionable gentlemen, that they clubbed together and presented her on Friday night with a really magnificent bouquet in basket. Mr. Cooper was spending the evening with President Morrison, and was not aware of the occurrence until his return to the hotel. It is said that his discovery of the episode led to a mysterious popping of numerous champagne corks in the early hours of the morning. Probably Mrs. Cooper will not be the only lady in attendance at the Detroit meeting.

Speaking of an evening at the president's reminds one of the fact that Mr. Morrison makes the best of hosts, his pronounced aggressiveness assuming the form of cordial and pressing hospitality, the assiduous attentions of Mrs. Morrison and himself being most refined and delicate. Among the treasures to be seen in Mr. Morrison's house is a remarkable old daguerreotype of Prof. S. F. B. Morse; a portrait very different indeed from the theatrical one by which the great inventor is generally known to the world to-day. Another provocative to an infraction of the tenth commandment is the choice and valuable collection of works on electricity, dating back as far as 1687. These books are not only bought up at any price, but are read, as various little bookmarks in many of them indicate. Besides collecting books, on a wide range of scientific and literary subjects, Mr. Morrison also has a taste for old china and pictures, possessing two very fine landscapes by Bolton Jones, as well as other canvases by well-known artists of equally high rank. When he tires of these and his books, he gives his time to the cultivation of roses, which he has in large number and great variety.

Much regret was felt at the absence of Mr. George S. Bowen, who has all along taken a keen interest in the success of the association, and who always wins applause by the manner in which he pours out his "heart affluence in discursive talk" on the merits of electric lighting and the great future immediately before it. However, next August the Association is going West to hunt him up.

Quiet, observant, highly conscientious and endowed with a rare faculty of seeing into things and getting at the inmost significance of abstruse problems, Mr. A. J. Holt, of the Brush Company, had won a great many friends, to all of whom his recent death came as a sad blow. The resolution of regret and condolence adopted by the Association was no empty form, and it was generally felt that in his death the organization had sustained a severe loss.

It was interesting to observe during the week how thoroughly alive electric light men are becoming to the need of dealing with the electrical power question. In fact, the Baltimore meeting will mark the beginning of a new era as far as this country is concerned, and thus the old Maryland city will add another to the laurels of which her mayor boasted so eloquently. Not only did the papers and discussions call attention to the subject in an impressive manner, but there was an actual electric railway to be ridden upon that had been in operation for more than six months with notable success on a very bad old horse car track, often under water, with curves ranging from 40 to 90 feet radius, and several gradients of over 250 feet per mile. The railway was visited and inspected by everybody, and the whole matter of power transmitted electrically was discuesed in public and private with the utmost eagerness. It would be difficult to say what will not be the result of impetus now given to the practical application of electro-motors. The ten or more projected electric street railways in New England are but a small proportion of the roads now being planned for all parts of the country, and the recent great improvements in motors is thought by even the most conservative to settle the question definitely and beyond a doubt in favor of electricity as compared with natural horse-power or mule power, steam or cable, to say nothing of the use of small motors in an endless variety of industrial pursuits, as exemplified at this moment in Boston.

Mr. Garratt's paper on lighting from primary batteries awakened much curiosity among the members, a curiosity that will be further stimulated when they learn that the batteries spoken of had by the 13th been running a lamp for 320 hours without any renewal of the Volta-Pavia solution, thus going far beyond the point of which Mr. Garratt had been advised by congratulatory telegrams from Boston. His company has been given an order to light both passenger elevators and both engine rooms for and at the expense of the New York Mutual Life Insurance Company, in whose building the present test has been made under the care of its superintendent, and it can, therefore, be depended upon as thoroughly genuine. The company now expects to reach 350 or 375 hours without renewal of the solution, thus far surpassing Mr. Garratt's most sanguine expectations as avowed to the many gentlemen who sought information from him.

While the Association fought rather shy of the underground wire question, it was ready enough to deal with that of insurance. Mr. Woodbury's paper met with a very hearty reception, while Mr. Gilbert's mutual plan was approved almost unanimously.

Difficulty would be experienced in naming a station run with greater efficiency and closer economy than the Brush station in Baltimore, the workings of which were very intelligently and clearly explained to all by Mr D. C. Evans. Next door to the station stands the new factory of the Southern Electric Company, of which Mr. Morrison and Mr. Tuxworth are proprietors. The four-story building is splendidly equipped, and is under the charge of Mr. H. E. Flemming as superintendent and Mr. T. McCoubray, Jr., as manager. One new instrument now being made there, of general utility, is a combined volt and ammeter.

Messrs. A. B. Proal and A. H. Bauer, of the Viaduct Manufacturing Company, of Baltimore, entertained a number of the delegates and explained the working of the storage system of electric lighting employed by their company. An extensive plant is now in operation at the Academy of Music, and it is rumored that the intention is to use the batteries on one of the Baltimore street car lines.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, Feb. 18, 1886.

At the Arion ball, which took place in this city on the evening of Feb. 8, some very pretty effects were produced by the aid of electricity. Mr. S. Bergmann, of Bergmann & Co., this city, had constructed a beautifully embellished arch of brass. Through perforations in the latter Edison lamps protruded, being so arranged as to form the word "Arion." The bulbs of the lamps were in colored glass, and their colored shades added considerably to the effect. The sides of the arch were entwined with smilax, and from the centre there was suspended a basket of flowers in the midst of which small glowing lamps shed their soft lustre. The *piece* won general admiration on all sides, and much credit is due to Messrs. Noll Bros., of 65 Fifth ave., who did the wiring for this novelty.

During the week the Post Building, at No. 16 Exchange place, was equipped with an incandescent plant of 200 lights by the United States Electric Lighting Company. Two dynamos are employed, one of 50 and another of 150 lights, with a 35 h. p. Armington & Sims engine.

Mr. E. W. Hazazer, formerly of Murray street, is now established at No. 32 Frankfort street, New York, where he has procured steam power and additional facilities for his growing business in the manufacture of bells, batteries, burglar alarms, annunciators, etc. Mr. Hazazer has given special attention to the production of a bell which he can warrant with perfect safety, one of its best features being the regulating device controlling the vibrating arm. Mr. Hazazer has just completed some extensive work in two large apartment houses in Brooklyn, upon which a large force of men have been engaged for some time. Buyers of bells, etc., in quantities should call or send for samples of Mr. Hazazer's goods.

The New York and New England Telephone Company, of 17 and 19 Broadway, this city, are the sole owners of the rights to introduce the "Consolidated" telephones in six New England and New York States. The article describing this system appeared in the issue of Jan. 2, and many testimonials in possession of the company, show it to possess all the advantages of a good telephone for private business purposes.

While calling upon Messrs. Brown and Brown, of 106 and 108 Liberty street of this city, recently, I was shown their "Earth Open Circuit Battery." The latter is constructed on a plan which is the reverse of the older forms. It consists of a porous cup inside of a glass cell, between which the carbons and chemicals are placed and sealed. The cup holds the sal-ammoniac, water and zinc. They claim several advantages for this form, one of them being, that if the battery be closed through neglect it does not polarize quickly, and should it run down, it will upon disconnection regain almost its original power. Messrs. Brown & Brown are also introducing "Zylonite," a new material which is well adapted for push buttons, etc. It is made in all colors and in imitation of ivory and tortoise shell.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Mass., Feb. 15, 1886.

The mechanical engineering laboratory of the Institute of Technology is now lighted by incandescent lamps. The Society of Arts held its 343d meeting at the institute last Thursday (Feb. 11) at 8 P. M. Mr. A. H. Cowles, of Cleveland, Ohio, read a paper on "The Cowles Electric Furnace and the Production of Aluminum and its Alloys." At the next meeting Mr. Charles Amory, of New York, will lecture on the distribution of steam.

Salem, Mass., City Hall will be lighted by the incandescent electric light. The electric light company has put in apparatus for the service.

The Brush Electric Light Co., Boston, has ordered several sets of Sheffield grate bars of the Jarvis Engineering Co., 61 Oliver street, Boston.

The New England Telephone Company's business for the three months ended Dec. 31, 1885, is published and I herewith give the figures, together with the totals of the various items for the calendar year:

	Quarter ended Dec. 31.	Year 1885.
Gross receipts	$221,100.67	$920,580.61
Gross expenses	167,079.03	668,091.60
Net earnings	$54,021.64	$252,489.01
Construction	1,458.38	68,461.36
Balance	$52,563.26	$184,027.65

Early on Friday afternoon last Inspectors Gerraughty and Mountain, at the instance of a Mr. Danforth of New York, took into custody Mr. Fred T. Hale, a banker and broker at 40 Congress street, on a technical charge of embezzlement. It appears that in May last a quantity of the New England Telephone Company's stock was sent to T. Brigham Bishop & Co., for whom Mr. Hale was then book-keeper on salary, to be sold. The firm subsequently failed, with the account unsettled, and Mr. Hale, who is now in business, claims that the prosecuting party is seeking to make him pay Bishop & Co.'s debts, having twice before brought civil suits against him with that end in view, insisting that Hale was at the time doing business for himself under the firm name. Mr. Hale promptly gave bail in $1,000.

The Kennebec (Maine) *Journal* reports a Western Union official as saying that in order to put the lines in that State in as good condition as before the storm an expense of $20,000 will be incurred.

W. I. B.

WESTERN NOTES.

INDIANAPOLIS, Feb. 17, 1886.

The Jenney Electric Company, of Indianapolis, is doing a business of very satisfactory proportions, and has orders on hand sufficient to keep it busy for two or three months. The company is going ahead rapidly, and among some of its late orders are the following: A 60-light arc plant for San Diego, Cal.; 24 of these lights are to go on towers. Waco, Texas, a 60-arc light plant. Corsicana, Texas, a 30-arc light plant, and a 200-light incandescent outfit. The city of Madison, Ind., a 50-arc light plant, which it is just increasing to 60 lights. George T. Smith Middlings Purifier Company, Jackson, Mich., three incandescent dynamos with complement of lamps. Brazil, Ind., is so well pleased with its Jenney plant, that it has just ordered the same doubled. Alameda, Cal., has just ordered a 25-arc light plant.

Charles L. Olds, formerly secretary of the company at Fort Wayne, is now connected with the Jenney Electric Company of Indianapolis. This company has also secured the services of Mr. John S. Adams, the well known inventor of the electric light tower bearing his name; and Mr. Adams, with the benefit of all his former experience, and in conjunction with the Jenney Company's experts, has brought out an entirely new tower of superior design and proportions, pleasingly symmetrical. This tower has been adopted as a standard by the Jenney Electric Company, who think it will become very popular with other companies.

A petition was presented at a late meeting of the Indianapolis City Council, by Charles F. Bidwell, asking permission to lay track and operate an electric street railway on certain thoroughfares in Indianapolis. The petition was referred to the Committee on Railroads. Mr. Bidwell has been in Indianapolis for two or three weeks past, endeavoring to interest local capital in an electric railroad to run from the Union Depot to Crown Hill Cemetery, a

distance of about four miles, and the above petition would seem to indicate that he is making satisfactory progress.

Mr. W. A. Hovey, of Boston, representing the American Bell Telephone Company, has been spending some days in Indianapolis.

Business is brisk just now with the Bennett Telephone and Electric Company, of Indianapolis. Besides doing considerable electric bell annunciator work, they find their orders for mechanical telephones exhibiting a satisfactory and material increase, and especially is this the case since the renewed activity manifested in the mining and manufacturing regions. W. A. K.

CINCINNATI, Feb. 15, 1886.

The Standerd Electrical Works, E. V. Cherry, Vice-President and General Manager, are very well satisfied with the volume of business which they are doing. In addition to a steady demand in all departments, their electric bell, burglar and fire alarm department is receiving more than ordinary attention from users of this class of material just at present, and the company's new hotel fire alarm is being especially favored by customers. This last the company is pushing vigorously, and has lately established an agency in London for its introduction abroad.

C. E. Jones & Brother, manufacturing electricians, find their business increasing steadily.

I was interested in seeing the many different things into which soapstone is made in the establishment of the D. M. Steward Manufacturing Company. Not only is this material used extensively in electric gas-lighting apparatus, but for some time the company has been experimenting with a view of producing electric light insulators, and the success which they have attained in this direction may perhaps be best illustrated by referring those interested to the strong testimonial letter which the Steward Manufacturing Company prints in its advertisement in your paper. The company will be glad to send its circulars to those asking for them. W. A. K.

DAYTON, O., Feb. 16, 1886.

The Dayton Carbon Company, although it has not been long in the business, is securing a fair share of the trade in its line. The company was represented at the electric light convention.

The Stout, Mills & Temple Company, manufacturers of the American turbine water-wheel, have furnished quite a number of their wheels to electric light companies, which have never failed to give satisfaction. Parties desiring descriptive circulars should write for them to the company at Dayton.

Brownell & Co. are manufacturers of an engine adapted to electric light purposes.

The turbine water-wheels of the Stilwell & Bierce Manufacturing Company are already in extensive use among electric light companies, and well known to your readers, having been illustrated in your paper some time ago. W. A. K.

THE TELEGRAPH.

Telegraph Material for China.—During the year 1884, telegraph wire and apparatus of British manufacture to the amount of £33,296 was exported to China. Why cannot our electrical supply houses secure some of this trade?

THE ELECTRIC LIGHT.

A New Lamp.—It is said that the Actiengesellschaft für Feilenfabrication of Berlin are about to bring out a new incandescent lamp, to be called the "Berlinoise."

THE TELEPHONE.

Investigating Both Sides.—The House of Representatives proposes to appoint a special committee to inquire into the connection of Government officers with the Pan-Electric Company and the charge that money has been used to control the selection of judges in courts that may have to decide litigation concerning telephone patents.

PERSONAL.

Marriage of Mr. E. P. Thompson.—On Wednesday evening, Feb. 10, Mr. E. P. Thompson, associate editor of THE ELECTRICAL WORLD, was married to Miss Edith Chetwood Coursen, daughter of Ex-Mayor Wm. A. Coursen, of Elizabeth, N. J. The ceremony took place at the bride's home, and an elaborate banquet was served after the wedding reception at which over 200 guests were present. At a late hour the happy couple departed on an extended bridal tour through the South and West.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange and elsewhere are as follows:

Telegraph.—Am. Dist., b 30, a 38; B. & M., b 2¼, a 3; Western Union, b 72¼, a 72⅝.

Telephone.—Am. Bell, b 159, a 161: Erie, b 28¾, a 29¼; Mexican, b 1⅛, a 1¼; New England, b 32, a 32½; Tropical, b 1, a 1¼.

Electric Light.—Edison, b 150.

BUSINESS NOTICE.

German Corn Remover

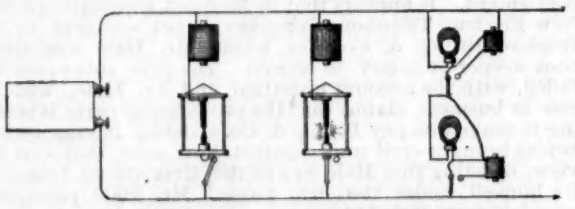
Kills corns and bunions, unfailing, rapid, painless; 25c.
HILL'S HAIR AND WHISKER DYE, black and brown; 50c.
PIKE'S TOOTHACHE DROPS will cure in one minute; 25c.
DEAN'S RHEUMATIC PILLS are a prompt, sure cure; 50c.
HALE'S HONEY, the great cough cure; 25c., 50c. and $1.
GLENN'S SULPHUR SOAP heals and beautifies the skin; 25c.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED FEBRUARY 2, 1886.

335,105. Armature; Hermann R. Boissier, New York, N. Y. Consist in forming the coils of cast-copper, made essentially U-shaped, and having their free ends coupled with adjacent commutator-sections; further, in a heavy U-shaped section for the armature and adapted to straddle the armature-core, in which one of the legs has its end bent so as to fit upon one commutator-section and the straight leg to fit upon another section.

335,158, 335,159, 335,160, 335,547. Motors and Lamps; Elihu Thomson, New Britain, Conn., Assignor to the Thomson-Houston Electric Co., Boston, Mass. In the first, a straight carbon rod is held by two carbon blocks pressed together by springs. The second relates to compound system shown in the cut. The third consists of fine metal and glass at the entrance of the conductors and of wire or band bent into a form for holding the filament. The fourth relates to a self-regulating motor, which consists of a field-magnet-charging coil, a variable resistance in a branch around the same, and a mechanism controlled by variations in the speed of rotation of the motor for controlling the set or adjustment of the resistance, so as to gradually and directly vary the magnetic field in which the armature revolves in ac-



335,159. SYSTEM OF ELECTRIC DISTRIBUTION.

cordance with changes in the load of the motor when operated upon a constant current line.

335,223. Fire Bucket Low Water Alarm; Charles J. Hexamer, Philadelphia, Pa. Provides a lever, having pail of water on one end and terminals of electric circuit including a bell on the other, so that when the water evaporates, the bell will ring.

335,275. Printing Telegraph; Richard N. Dyer, New York, N. Y., Assignor to the Commercial Telegram Company of same place. The type wheel shafts are hollow, and there passes completely through the center of both of them a third or escapement shaft. This third shaft has a scape-wheel, and a single pallet, operating to control the scape-wheel, is connected directly with the magnet-armature, and is vibrated thereby. The escapement-shaft is coupled with the type-wheel shafts by pawls and ratches. This escapement shaft is turned by both type-wheel shafts when both type-wheels are revolving; but when one type-wheel is stopped at its blank space or unison the shaft of the other type-wheel turns the escapement-shaft alone, the pawl-and-ratchet connections permitting this to be done.

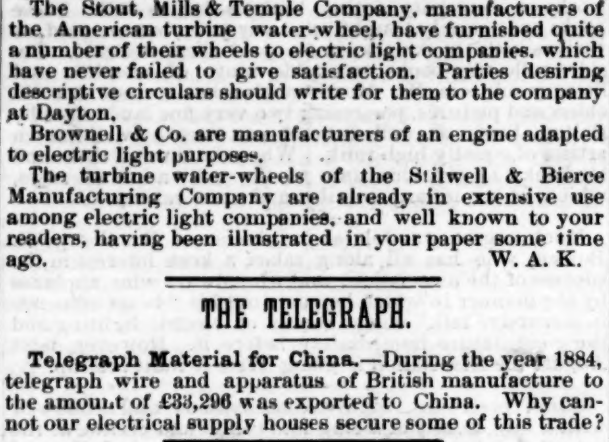
335,269. Electric Switch; Charles F. Brush, Cleveland, Ohio. Its object is to open or close simultaneously a circuit at two points.

As shown in the cut, the switch consists of an insulating-block made angular in cross-section, and an electric conductor projecting outwardly from the two opposite plane surfaces of the block, said conductor being of less width than said plane surfaces to insure plane surfaces of insulating material adjacent to and on opposite sides of each end of the conductor, a pair of spring contact-arms arranged to press on opposite sides of the insulating block or conductor, whereby imperfect contacts are avoided and the switch positively retained in its open or closed position.

335,294. Telephone Transmitter; James F. McLaughlin, Philadelphia, Pa. Consists of a freely-supported bar having an attached zinc plate, and a button interposed between said diaphragm and plate.

335,325, 335,326. Dynamos; William L. Voelker, Morton, Pa., Assignor to John H. Irwin, trustee, of same place. In the first he covers the surface of the armature discs with diamagnetic substance. In the second the pole-pieces and cores are built up of sheets and similarly covered.

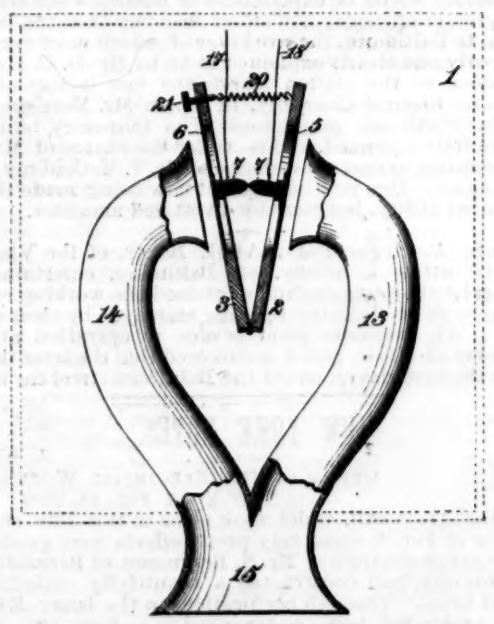
335,355. Dynamo-Electric Machine; Carl Hering, Philadelphia, Pa., Assignor of one-half to Charles H. Banes, of same place. The method consists in winding a cylindrical armature, whereby the wire is so disposed thereon as to cause the current generated in the coils that



335,482. PRINTING TELEGRAPH.

are short circuited to flow in opposite directions instead of the same direction, so that the difference of the currents, instead of their sum, appears in the injurious spark at the commutator.

335,364. Telephone Transmitter; Albert K. Keller, Boston, and Edward H. Lyon, Chelsea, Assignors to the American Bell Telephone Co., Boston, Mass. Consists of a stationary or non-vibratory electrode, which is provided with internal and circumferential chambers,



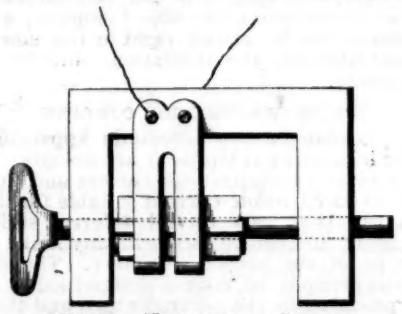
335,501. TELEPHONE TRANSMITTER.

the said chambers being connected by lateral channels and adapted to be independently supported in the containing-chamber with its lower surface opposite and near to the vibratory electrode.

335,417. Galvanic Belt; Henry M. Beidler, Texarkana, Arkansas. Consists of the battery inclosed in a casing which is adjustable upon a belt and one of the walls of which forms a body-electrode, and adjustable opposite electrode mounted upon the same belt and electrically connected with the pole of the battery opposite that which is connected with its said body-electrode.

335,436. Telephone Circuit; Thomas V. Doolittle, Bridgeport, Conn. Consists of an arrangement of apparatus for telephone-exchanges, whereby single-line or ground-return circuits may be readily connected with metallic circuits for the purpose of electrical communication. A switch-board containing the terminals of circuits of both classes, equipped with annunciators and switching devices, is provided with an inductorium composed of two coils, preferably of nearly equal resistance. The terminals of each coil are connected to spring-jacks or equivalent switching devices. One coil is connected to a switch of such form that a ground-return circuit may readily be connected thereto, and the other coil is connected to a switching device of such form that a double-line or metallic circuit may be connected thereto.

335,459. Electric Arc Lamp; Friederich Klostermann, Vienna, Austria-Hungary. Consists of carbon-holders, a feeding mechanism, a rheotomic magnet actuating



335,269. ELECTRICAL SWITCH.

said mechanism, a normal shunt-circuit around the arc traversing the exciting-coil of said magnet and the rheotomic contacts, a demagnetizing shunt-circuit traversing a coil of said magnet in the opposite direction to said normal shunt-circuit, and electrical connections, whereby on the rheotomic breaking of said normal shunt-circuit a reverse current is caused to pass through said demagnetizing-circuit, and the core of said magnet is thereby demagnetized and its retraction is accelerated.

335,482. Printing Telegraph; Arthur C. Robbins, Buffalo, Assignor of one-half to Edward C. Cole, Albion, and John D. Larkin, Buffalo, N. Y. Consists, as shown in the cut, of a pair of geared cylinders provided with movable and fixed type respectively, an axis passing through and supporting one of said cylinders, and a frame provided with inwardly-projecting friction-rollers, between which the other cylinder is supported.

335,501, 335,502. Telephone Transmitters; William Burnley, North East, Pa., Assignor of two-thirds to Charles A. Hitchcock, of same place, and Lewis Watson, of Warren, Pa. The first is clearly shown in the cut. The second consists of a modification of the first.

335,510, 335,511. Telephone Transmitters; North Dowling, Philadelphia, Pa. The second is an improvement upon the first, which consists in the combination, with the diaphragm and platinum contact-point, of a carbon-bearing lever and counterpoise with a spring and elastic sleeve.

335,522. Telephony; James J. Houlehan, Toledo, O., assignor of one-half to William A. Bunton, Boston, Mass., and seven-sixteenths to J. S. Barker and E. E. Dwight, Toledo, O. Consists in specially combining a telephone with a phonograph, whereby the oral communications over a telephone line may be automatically recorded.

335,548. Electric Switch; Elihu Thomson, Lynn, Mass. Consists of two circuit-closing springs arranged side by side, an intermediate reciprocating connecting-piece moving on a line transverse to the line joining said springs and making contact with one spring before it makes connection with the other.